



## **I-70 EAST**

SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT  
AND SECTION 4(F) EVALUATION

## **AIR QUALITY TECHNICAL REPORT**

ATTACHMENT J

AUGUST 2014



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# List of acronyms

APCD	Air Pollution Control Division
CAA	Clean Air Act
CAMP	Continuous Ambient Monitoring Program
CCD	City and County of Denver
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Health and Environment
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	Carbon monoxide
CO <sub>2</sub>	Carbon dioxide
DEH	Department of Environmental Health
DIA	Denver International Airport
DPM	Diesel particulate matter
DRCOG	Denver Regional Council of Governments
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
FR	Federal Register
FTA	Federal Transit Administration
GHG	Greenhouse gas
HAP	Hazardous Air Pollutant
mg/m <sup>3</sup>	Milligrams per cubic meter of air
MMT	Million metric tons
MOBILE	Mobile Source Emission Model (EPA)
MOVES	Motor Vehicle Emission Simulator
MSAT	Mobile source air toxic
NAAQS	National ambient air quality standards
NEPA	National Environmental Policy Act
NO <sub>2</sub>	Nitrogen dioxide
NO <sub>x</sub>	Nitrogen oxides
O <sub>3</sub>	Ozone
PACT	Preferred Alternative Collaborative Team
PM	Particulate matter
ppb	Parts per billion
ppm	Parts per million
RTD	Regional Transportation District

RTP	Regional transportation plan
SIP	State implementation plan
SO <sub>2</sub>	Sulfur dioxide
TIP	Transportation improvement program
TSD	Technical Support Document
USC	United States Code
VHT	Vehicle hours of travel
VMT	Vehicle miles of travel
VOC	Volatile organic compounds
µg/m <sup>3</sup>	micrograms per cubic meter

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# 1. Introduction

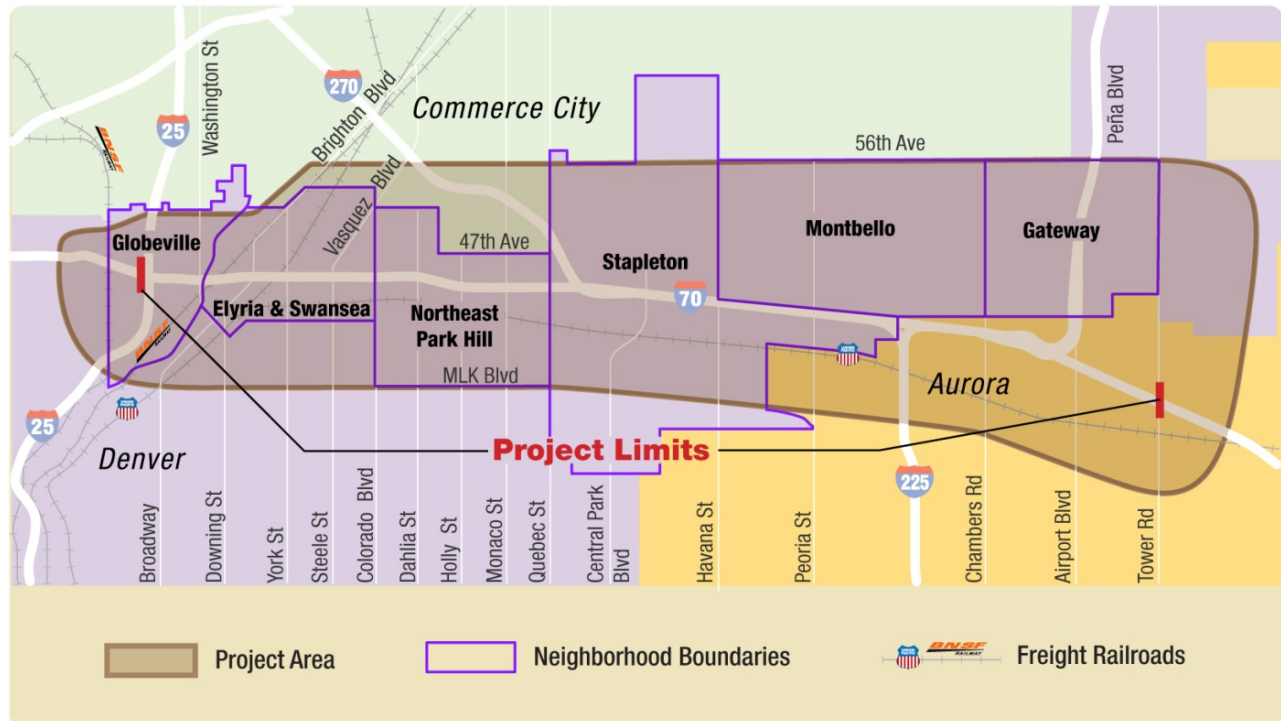
The I-70 East Environmental Impact Statement (EIS) is a joint effort between the Federal Highway Administration (FHWA) and the Colorado Department of Transportation (CDOT). The intent of the EIS is to identify potential highway improvements along I-70 in the Denver metropolitan area between I-25 and Tower Road and to assess their potential effects on the human and natural environment. This technical report describes the methodology used and presents the results of the air quality analyses for the I-70 East corridor based on three fundamental components:

- Carbon monoxide hotspot analysis;
- Particulate matter hotspot analysis (for PM<sub>10</sub>, specifically); and
- Emissions inventory burden analysis for National Ambient Air Quality Standards (NAAQS) criteria pollutants, mobile source air toxics, and greenhouse gases.

## 1.1. Project limits

As shown on Figure 1, the project limits extend along I-70 between I-25 and Tower Road. The project area covers portions of Denver, Commerce City, Aurora, and Adams County. This area includes the neighborhoods of Globeville, Elyria and Swansea, Northeast Park Hill, Stapleton, Montbello, and Gateway. The portion of Aurora in the project area is referred to as the Aurora Neighborhood in this report. Each resource has a specific study area based on the resource.

**Figure 1. Project area**



## 1.2. Project background

Analysis of I-70 began in June 2003 as part of the I-70 East Corridor EIS, a joint effort conducted by CDOT, FHWA, the Regional Transportation District (RTD), the Federal Transit Administration (FTA), and the City

and County of Denver (Denver). In June 2006, CDOT and RTD determined that the highway and transit elements of the I-70 East Corridor EIS process serve different travel markets, are located in different corridors, and have different funding sources. The highway and transit components of the analysis were, therefore, separated.

After the project separation, the alternatives that made it through the screening process by addressing the purpose and need of the project were fully evaluated in the Draft EIS, published in November of 2008. With the release of the 2008 Draft EIS, the public and agencies had an opportunity to review and comment on it. Public hearings were held to present the information and encourage formal comments. Due to the complexity of the project and the extensive amount of public comments received during the formal comment period, the project team decided to form the Preferred Alternative Collaborative Team (PACT) as part of a collaborative process with project stakeholders to recommend a preferred alternative. Through this collaborative process, additional analysis was performed, which resulted in the elimination of two previous alternatives and the addition of a new alternative.

Because more than four years had passed since the 2008 Draft EIS was first published, many federal and state regulations and requirements had changed. Additional analysis and public involvement efforts were performed to determine the validity of the alternatives that were considered reasonable alternatives in the 2008 Draft EIS. Based on the public comments, the additional analysis, and the PACT collaborative process, the project team determined that the Realignment Alternatives using I-270 were no longer reasonable. Consequently, a new alternative option was designed to address the public concerns and incorporate their comments. Due to the changes in the alternatives, outdated census data, and new federal and state laws and regulations, the analysis in the 2008 Draft EIS was revisited and the Supplemental Draft EIS was written.

### **1.3. Update to the air quality analysis**

The air quality analysis for the Supplemental Draft EIS differs from the 2008 Draft EIS because of the new alternatives, new regulations and guidance, and other changes, as follows:

- The Environmental Protection Agency (EPA) mobile emissions model has been updated from Mobile Source Emission Model (MOBILE) to the Motor Vehicle Emissions Simulator (MOVES).
- For the carbon monoxide (CO) analysis, a worst-case scenario has been modeled for the Supplemental Draft EIS rather than all of the locations modeled in the 2008 Draft EIS. If modeling the worst-case location produces emissions results that do not exceed the CO standard, it can be assumed that the other locations would meet the standard as well.
- For the analysis of particulate matter (PM) of 10 microns or less (PM<sub>10</sub>), a quantitative analysis is added where a qualitative analysis was used in the 2008 Draft EIS. The quantitative analysis is being conducted to address concerns about exposure to PM concentrations from residents in the corridor.
- A year of peak emissions sensitivity analysis was conducted for PM<sub>10</sub> to verify (or determine otherwise) that the design year of 2035 is when emissions peak.
- The number of mobile source air toxics (MSATs) to be analyzed rose from six to seven. The MSAT analysis includes emission inventories for the following pollutants: acrolein, benzene, 1,3 butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter (POM).
- New study areas were defined for the regional and hotspot analyses.
- The design year has changed from 2030 to 2035. Where the 2008 Draft EIS included emissions estimates for 1990 and 2001, they have been eliminated because they were based on data from different sources which did not result in meaningful trends.

- An analysis of greenhouse gas (GHG) emissions has been added to the air quality analysis for the Supplemental Draft EIS.
- Traffic data from the Denver Regional Council of Governments (DRCOG) Compass model is being used for the Supplemental Draft EIS.

In addition to the changes listed, the approach for the Supplemental Draft EIS goes beyond federal requirements in several areas because of air quality concerns expressed during the public involvement process for the 2008 Draft EIS.

## 1.4. Report overview

This report describes the air pollutants of interest that were analyzed and identifies the regulations and guidance used to establish the methodology and assumptions for the analyses. This report also documents existing air quality conditions in the project area, describes the methodology used in the air quality analysis, discusses results of the analysis and effects of the alternatives and options on air quality, and presents potential mitigation measures to reduce air emissions during construction and operation of the highway.

# 2. Resource Definition

The primary air quality concerns for potential I-70 East highway improvements focus on the exposure of local populations to criteria pollutants, MSATs, GHGs, and fugitive dust from construction activities.

## 2.1. Criteria pollutants

The Clean Air Act of 1970 (CAA), as amended, identifies six commonly found air pollutants, also known as criteria pollutants, as harmful to human health and the environment.

**Ground-level ozone (O<sub>3</sub>).** Ozone is a pollutant created by the chemical reaction of volatile organic compounds (VOC) and nitrogen oxides (NO<sub>x</sub>) in the presence of sunlight. The O<sub>3</sub> molecule is formed through this chemical transformation, which typically occurs downwind from the VOC and NO<sub>x</sub> emission sources. As a result, ozone is considered a regional rather than localized street or intersection issue, and an individual highway project will typically have little or no effect on regional ozone concentrations. Ozone is evaluated using the VOC and NO<sub>x</sub> emission precursors in an emission inventory burden analysis instead of a localized, or hotspot, analysis.

Health effects include breathing problems, reduced lung function, asthma, irritated eyes, stuffy nose, reduced resistance to colds and other infections, and acceleration of the aging of lung tissue. Ozone also damages plants, trees, rubber products, fabrics, and other materials. As of 2012, the Denver region is classified as nonattainment for the 8-hour 1997 and 2008 ozone standards. The region was originally designated under the 1-hour standard, which has since been replaced with an 8-hour standard in 1997 and updated in 2008.

**Particulate matter.** PM is a complex mixture of very small particles and liquid droplets classified as either inhalable coarse-sized particles (PM<sub>10</sub> refers to particles 10 microns or less) or fine particles (PM<sub>2.5</sub> refers to particles 2.5 microns or less). PM includes diesel tailpipe emissions; road, brake, and tire dust; and dust due to construction activities (particulate matter is not a major component of emissions from gasoline-powered vehicles, which are the predominant source of traffic in this corridor).

Health effects include nose and throat irritation, lung damage, and bronchitis. PM<sub>10</sub> has been a concern in the Denver region in the past, but the region is currently in attainment/maintenance for this pollutant. The Denver nonattainment area was redesignated to attainment/maintenance status by the Environmental Protection Agency (EPA) on September 16, 2002 (EPA, 2002) and has maintained the NAAQS since that time.

There has been one exceedance of the 24-hour PM<sub>2.5</sub> standard since 1999 at one monitoring station in 2001.

**Carbon monoxide.** CO is a colorless, odorless gas emitted directly from vehicle tailpipes as a product of combustion. Because of this, CO tends to concentrate at intersections with high vehicle delays and poor level of service. CO reduces the ability of blood to bring oxygen to body cells and tissues. High concentrations of CO may be particularly hazardous to people who have heart or circulatory problems and people who have damaged lungs or breathing passages. In severe cases, CO poisoning can cause death.

CO has been a concern in the Denver region in the past, but the region was redesignated to an attainment/maintenance area for this pollutant in December 2001 (EPA, 2001). **Nitrogen dioxide.** Nitrogen dioxide (NO<sub>2</sub>) is a highly reactive gas that is emitted during the combustion process. Health effects include lung damage and illnesses of the respiratory system. NO<sub>2</sub> has not been and is not currently an issue in the Denver region or the state of Colorado. According to EPA's Green Book Website, the only area in the country that has NO<sub>2</sub> concerns is the Los Angeles basin (EPA, 2012).

**Sulfur dioxide.** Sulfur dioxide (SO<sub>2</sub>) is one of a group of highly reactive gases emitted during the combustion process. SO<sub>2</sub> causes breathing problems and lung damage. The Denver region has not had exceedances of the SO<sub>2</sub> standard, nor has any location within Colorado. Sulfur dioxide is a pollutant of general air quality concern and contributes to the overall air shed of the project study area. Sulfur dioxide is not considered a transportation-related criteria pollutant.

**Lead.** Lead is a metal found naturally in the environment. It is used in manufacturing and historically was added to gasoline to reduce engine knocking, boost octane ratings, and decrease wear and tear on engine components. Lead poisoning causes serious health effects, including seizures, high blood pressure, learning disabilities, behavioral disorders, and central nervous system problems. Lead has been phased out of paint and automotive fuels. Monitoring data show that lead is not a pollutant of concern in the Denver region.

The six criteria pollutants are regulated by EPA through the NAAQS, which defines primary and secondary limits for these air pollutants based on human health and environment/property damage, respectively. Table 1 summarizes the concentration standards for the NAAQS criteria pollutants. Each of the criteria pollutants has been proven through scientific study to have adverse effects on human health and the environment and/or property.

EPA tracks these criteria pollutants in two ways: through actual measurements of pollutant concentrations in the air at monitoring sites across the nation, including the Denver region, and through analytical estimates of emissions based on implementation of transportation plans, improvement programs, and individual projects.

To summarize, of the NAAQS criteria pollutants, only CO, PM<sub>10</sub>, and ozone have been of concern in the Denver region, and ozone is the only pollutant of which the region is currently in nonattainment. The region was originally designated under the 1-hour standard, which has since been replaced with an 8-hour standard in 1997 and updated in 2008. The Denver region was redesignated to attainment/maintenance status for PM<sub>10</sub> by the EPA on September 16, 2002 (EPA, 2002a), and for CO on December 14, 2001 (EPA, 2001).

**Table 1. National Ambient Air Quality Standards**

Pollutant	Primary Standards	Averaging Time	Secondary Standards	Form	Final Rule Citation
CO	9 parts per million (ppm)	8-hour	None	Not to be exceeded more than once per year	76 Federal Register (FR) 54294 August 31, 2011
	35 ppm	1-hour	None	Not to be exceeded more than once per year	
Lead	0.15 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ )	Rolling three-month average	Same as Primary	Not to be exceeded	73 FR 66964 November 12, 2008
NO <sub>2</sub>	53 parts per billion (ppb)	Annual	Same as Primary	Annual mean must not exceed standard	75 FR 6474 February 9, 2010; 61 FR 52852 October 8, 1996
	100 ppb	1-hour	None	98th percentile averaged over three years must not exceed standard	
PM <sub>10</sub>	150 $\mu\text{g}/\text{m}^3$	24-hour <sup>3a</sup>	Same as Primary	Not to be exceeded more than once per year on average over three years	78 FR 3086 January 15, 2013
PM <sub>2.5</sub>	12 $\mu\text{g}/\text{m}^3$	Annual	15 $\mu\text{g}/\text{m}^3$	Annual mean averaged over three years must not exceed standard	
	35 $\mu\text{g}/\text{m}^3$	24-hour <sup>5</sup>	Same as Primary	98th percentile averaged over three years must not exceed standard	
Ozone	0.075 ppm	8-hour	Same as Primary	Annual fourth- daily maximum 8-hour concentration, averaged over three years must not exceed standard	73 FR 16436 March 27, 2008
SO <sub>2</sub>	75 ppb <sup>7</sup>	1-hour	none	99th percentile of 1-hour maximum concentrations averaged over three years must not exceed standard	75 FR 35520 June 22, 2010 38 FR 25678 September 14, 1973

**Source:** EPA, 2014 (<http://www.epa.gov/air/criteria.html>)

<sup>1</sup> Not to be exceeded more than once per year.

<sup>2</sup> The annual average standard for PM<sub>10</sub> was revoked by EPA in a rule making in September 2006. The previous standard was 50  $\mu\text{g}/\text{m}^3$ .

<sup>3a</sup> To attain this standard, the three-year average of the annual arithmetic mean PM<sub>2.5</sub> concentrations from single or multiple community-oriented monitors must not exceed 15  $\mu\text{g}/\text{m}^3$ .

<sup>4</sup> This standard was revised from 65 to 35  $\mu\text{g}/\text{m}^3$  by EPA in a rule making in September 2006, and will be implemented over a lengthy period. To attain this standard, the three-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35  $\mu\text{g}/\text{m}^3$ . This standard becomes effective December 18, 2006.

<sup>5</sup> To attain this standard, the three-year average of the fourth highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

<sup>6</sup> (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is  $\leq 1$ . (b) The 1-hour standard is applicable to all areas notwithstanding the promulgation of 8-hour ozone standards under Sec. 50.10. On June 2, 2003, (68 FR 32802) EPA proposed several options for when the 1-hour standard would no longer apply to an area.

## 2.2. Mobile source air toxics

As part of the Hazardous Air Pollutants (HAP) Program of the CAA Amendments of 1990, EPA has identified approximately 188 pollutants that are known to cause health problems. Generally, the HAP pollutants are not monitored, and EPA has not established exposure thresholds and concentration standards for them. This is an ongoing area of study, but to date no limits have been set.

Of the 188 HAP toxic air pollutants, 21 have been identified by EPA as Mobile Source Air Toxics (MSATs). MSATs are compounds emitted from motor vehicles and equipment that are known or suspected to cause cancer or other serious health and environmental effects.

Of the 21 MSATs, EPA has indicated that the majority of adverse health effects are from seven pollutants, which FHWA has labeled as priority MSATs for National Environmental Policy Act (NEPA) studies.

**Benzene.** Benzene is a component of gasoline vapors and motor vehicle exhaust. Acute (short-term) exposure can cause eye, skin, and respiratory tract irritation, while chronic (long-term) exposure can cause blood disorders, reproductive effects, and cancer.

**Formaldehyde.** Formaldehyde is a component of motor vehicle exhaust. Both acute and chronic exposure can result in respiratory symptoms, as well as eye, nose, and throat irritation. The EPA also considers formaldehyde a probable human carcinogen.

**Naphthalene.** Naphthalene is a component of motor vehicle exhaust. Acute and chronic exposure can lead to anemia and cataracts, as well as liver and neurological damage. The EPA considers naphthalene a possible human carcinogen.

**Diesel Particulate Matter (DPM)/Diesel Exhaust Organic Gases.** DPM and organic gases constitute a mixture of numerous pollutants released during the combustion of diesel fuel. Acute exposures can cause irritation and inflammation, and may exacerbate allergies and asthma symptoms. Chronic exposure may damage the lungs in various ways, and likely poses a lung cancer hazard.

**Acrolein.** Acrolein is a component of motor vehicle exhaust. Acute and chronic exposure may result in upper respiratory tract irritation and congestion, as well as irritation to the eyes. It is unclear from the scientific evidence if acrolein poses a reproductive or cancer risk to humans.

**1, 3 Butadiene.** 1, 3 butadiene is a component of motor vehicle exhaust that breaks down quickly in the atmosphere, but nonetheless is found in the ambient air at low levels in urban and suburban areas. Acute exposure causes irritation of the eyes, nasal passages, throat, and lungs. Chronic exposure may result in cardiovascular diseases, leukemia, and other cancers.

**Polycyclic Organic Matter (POM).** POM defines a broad class of compounds, including polycyclic aromatic hydrocarbons (PAHs), which are formed by combustion and are present in the atmosphere in particulate form. Compounds in this class may have various acute effects, but the principal concern is that chronic exposure can increase the risk of cancer in humans.

Based on FHWA's analysis using EPA's air quality models, DPM is the dominant MSAT of concern.

EPA has programs to reduce emissions of many MSATs through control technologies and other methods. Primary among these is EPA's Control of Hazardous Air Pollutants from Mobile Sources: Final Rule to

Reduce Mobile Source Air Toxics, issued February 26, 2007, to significantly lower emissions of benzene and other air toxics. Tools and techniques for assessing MSATs are limited, however, and there are no approved exposure-concentration limits.

### **2.3. Greenhouse gases**

GHGs trap heat and make the planet warmer. The primary sources of GHG emissions in the United States are from electricity production, transportation, industry, commercial and residential activities, and agriculture. Most of the emissions are due to the burning of fossil fuels, such as petroleum, coal, and natural gas. Others are due to the handling and waste management of certain chemicals. Recent concerns with climate change (global warming) have prompted calls to reduce GHGs, of which carbon dioxide (CO<sub>2</sub>) is the primary component.

The full effects of global warming caused by GHGs are largely unknown but potentially very serious, including changes in precipitation causing flooding and drought; heat waves; warming of the oceans with the associated melting of the ice caps and rising sea levels; and higher acidity in the oceans.

### **2.4. Construction fugitive dust**

Fugitive dust in the lower atmosphere is a type of particulate matter and is harmful to humans and the environment. Fugitive dust has been linked to asthma, emphysema, chronic obstructive pulmonary disease, bronchitis, and heart disease. It is also a component of haze, which causes visibility problems. It has both natural and man-made causes. Natural examples of fugitive dust include wind erosion and wildfires. Human activities that cause fugitive dust include agriculture, construction, commercial and industrial operations, burning materials, vehicle exhaust, and travel (for example, unpaved roads, tire wear, and brake dust). The term “fugitive” refers to the widespread or open area sources of the dust as compared to a single point source such as a smokestack.

Fugitive construction dust is only one component of lower atmospheric dust and PM, but it is singled out for special consideration due to the potential effects on people within or near a major construction project such as I-70 East. Dust particles can be so small that they pass through the nasal cavity and into the lungs to cause damage. Also, toxic and cancer-causing chemicals can attach to dust and produce much more profound effects when inhaled. These situations may be worsened during construction projects requiring longer durations to complete.

## **3. Applicable Laws, Regulations, and Guidance**

Several applicable laws, regulations, and guidance were used for the analysis of air quality in this report.

### **3.1. National Environmental Policy Act**

NEPA was passed by Congress in 1969 and signed into law by President Nixon on January 1, 1970. NEPA came into existence following a period of increased concern for human impacts on the natural and human environments. It mandates that transportation decisions involving federal funds and approvals consider social, economic, and environmental factors in the decision-making process. NEPA also requires that agencies making such decisions consult with other agencies, involve the public, disclose information, investigate the environmental effects of a reasonable range of alternatives, and prepare a detailed statement of the environmental effects of the alternatives. NEPA set up procedural requirements for all federal government agencies to prepare environmental assessments and EISs for projects that will use federal funding or require a federal permit such as a major highway project like I-70 East.

### **3.2. Council on Environmental Quality Regulations**

NEPA also established the President's Council on Environmental Quality (CEQ) to oversee NEPA implementation and maintain compliance. CEQ regulations provide specific guidance to federal agencies in developing environmental impact statements while allowing agencies to set their own implementing procedures. The regulations require that an EIS be prepared when a proposed action is projected to have a significant impact on the quality of the human environment. Under the CEQ regulations, EIS documents must provide full and fair discussion of significant environmental impacts and inform decision makers and the public about project alternatives.

### **3.3. Clean Air Act**

Air quality is regulated at the national level by the Clean Air Act of 1970, as amended in 1977 and 1990. The Act regulates emissions through the NAAQS and HAP programs, which includes MSATs. EPA has set primary (health) and secondary (environment and property) limits for the NAAQS criteria pollutants previously described. Specific requirements are placed on the transportation planning process in air quality nonattainment areas that do not meet the NAAQS emissions limits and in areas that have been reclassified from nonattainment to attainment/maintenance areas.

### **3.4. Transportation Conformity Rule**

Transportation conformity is the link between air quality planning and transportation planning. It is required under CAA section 176(c) to ensure that federally supported highway and transit projects are consistent with air quality goals in the state implementation plan (SIP). The Transportation Conformity Rule 40 CFR 93 promulgated through CAA legislation is the mechanism through which transportation plans, programs, and projects are evaluated for air quality impacts in nonattainment and attainment/maintenance areas. The goal of transportation conformity is to ensure that FHWA and FTA funding and approvals are made for highway and transit actions that are consistent with air quality goals.

The air quality conformity process has two levels: regional air quality conformity and project-level conformity. The regional conformity analysis is conducted for the regional transportation program (RTP) and the transportation improvement program (TIP). Regional conformity ensures that the RTP and TIP and the financially-constrained projects therein are consistent with the SIP emissions budgets (i.e., limits) in the air quality SIP. In nonattainment areas, regional conformity analyses are conducted at least every 4 years as well as on an as-needed basis.

Regional and project-level conformity applies to transportation projects in air quality nonattainment and attainment/maintenance areas. Project-level conformity is conducted for projects that are funded and/or approved by FHWA or FTA and/or considered regionally significant. To pass regional conformity, the project must be included in a conforming RTP and TIP. Project level conformity also includes a hotspot analysis in carbon monoxide areas and for projects of air quality concern in PM areas. The term hotspot analysis is used for convenience for the following analysis. It is not used for air quality conformity purposes. A project cannot create new, increase the frequency of, or exacerbate the severity of air quality. Furthermore, the design and concept for the proposed project must be adequately defined and must remain consistent with the project's definition in the conforming RTP and TIP. If the project changes in concept or design during the planning process, or if it was not originally included in the RTP and TIP, the regional conformity analysis would need to be revisited before the project can proceed (40 CFR 93.107). Because this is the Supplemental Draft EIS, the purpose of this EIS is not to determine regional or project-level conformity. As a proactive measure, a project-level analysis was performed to evaluate whether alternatives of the project would meet the relevant NAAQS and conformity, if implemented. The actual regional and project-level conformity determination will be made during the Final EIS.

### **3.5. Colorado Air Pollution Prevention and Control Act**

At the state level, there are the Colorado Air Pollution Prevention and Control Act of 1992 and the Colorado Air Quality Control Commission (AQCC) Regulations. The Act was passed to foster the health, welfare,

convenience, and comfort of the inhabitants of the state of Colorado and to facilitate the enjoyment and use of the scenic and natural resources of the state. Policy direction under this act is intended to achieve the maximum practical degree of air purity in every portion of the state, to attain and maintain NAAQS, and to prevent the significant deterioration of air quality in those portions of the state where the air quality is better than the NAAQS. AQCC's Regulation No. 10, Transportation Conformity defines the criteria used to evaluate consistency between state air quality standards/objectives and transportation planning and major construction activities across the state as defined in SIPs. The state law and regulations are focused on the implementation and monitoring of control measures for reducing air pollution.

## 4. Methodology

The air quality analysis for the Supplemental Draft EIS differs from the 2008 Draft EIS due to the new alternative options, new regulations and guidance, and other changes, as stated in Section 1.3, Update to the air quality analysis. In addition to the changes listed in Section 1.3, the approach for the Supplemental Draft EIS goes beyond federal requirements in several areas because of air quality concerns expressed during the public involvement process for the 2008 Draft EIS.

Traffic data from the DRCOG model are being used to conduct the air quality analysis for the Supplemental Draft EIS. The DRCOG model data comes from Compass and not the newer Focus regional travel demand model. The Compass model is the official model for use on project-level studies in the region. Forthcoming traffic data from the FHWA approved DynusT model will be compared to the DRCOG model traffic data through a series of sensitivity tests. If data from the two sources are reasonably close, the Final EIS will continue to use the DRCOG model data. Where they differ, adjustments will be made as necessary up to and including revising portions of the analysis using the DynusT data. The DRCOG model results being used for the Supplemental Draft EIS use the revised socio-economic forecasts and roadway networks produced by DRCOG in fall of 2012.

The following sections identify the air quality study area and the methodologies used for the CO and PM<sub>10</sub> hotspot analyses and the emissions inventory burden analysis for NAAQS criteria pollutants, MSATs, and GHGs.

### 4.1. Study area

The air quality analysis for I-70 East is based on both a large geographic study area that encompasses the corridor and surrounding neighborhoods and localized hotspot areas that are focused on an intersection or interchange. These study areas are shown in Figure 2. The green shading on the graphic represents PM hotspot analysis areas and the orange shading is for the CO hotspot analysis.

**Figure 2. Air quality study areas**



## 4.2. Interagency consultation

An Interagency Consultation process was established to support the air quality analysis of CO, PM<sub>10</sub>, and other pollutants. Although section 93.105 of the Transportation Conformity Rule requires an Interagency Consultation process, it was used to establish the methodology and requirements for both conformity and NEPA. Because this is the Supplemental Draft EIS, the purpose of this EIS is not to determine regional or project-level conformity. The Supplemental Draft EIS air quality analysis followed conformity requirements to ensure air quality conformity methods were met. As the project sponsor, CDOT initiated consultation with staff from the Air Pollution Control Division (APCD) of the Colorado Department of Public Health and Environment (CDPHE), the EPA, and the FHWA through working group meetings, informal correspondence (e.g., e-mail), and a formal Interagency Consultation meeting. This group effort resulted in a common understanding of the assumptions and methodology to be used for conducting the air quality analyses. Specific items established through the Interagency Consultation process include:

- Geographic area covered by the analysis
- Emissions model, air dispersion models, and input parameters used in the analysis
- Years of analysis
- Specific pollutants to analyze
- Whether and how to estimate road and construction dust emissions
- Nearby emissions sources to be considered

- Background monitors and concentrations for the hotspot analyses
- Intersections and/or interchange areas for the hotspot analyses
- Project-specific data assumptions
- Appropriate placement of receptors for the hotspot analyses

These assumptions were documented in an Air Quality Protocol that was reviewed by the consulting agencies and updated through the Interagency Consultation process. The Protocol is included as Appendix A.

### **4.3. Carbon monoxide hotspot methodology**

The Denver region is an attainment/maintenance area for the pollutant CO. Because of this, a quantitative project-level hotspot analysis was conducted for the I-70 Supplemental Draft EIS. Section 93.116(a) of the Transportation Conformity Rule requires that emissions from a proposed FHWA or FTA project—when considered with existing background concentrations—will not cause or contribute to any new violations, worsen existing violations, or delay timely attainment of the NAAQS or any required interim emissions reductions or other milestones. These criteria are satisfied for projects in CO attainment/maintenance areas using a hotspot analysis.

As defined in Section 93.101 of the Transportation Conformity Rule, a quantitative “... hotspot analysis is an estimation of likely future localized ... pollutant concentrations and a comparison of those concentrations to the national ambient air quality standards.” A hotspot analysis is conducted at specific locations, such as congested roadway intersections. It uses an on-road mobile emissions model combined with an air quality dispersion model to determine design values that represent local pollutant concentrations. As long as the estimated concentrations for the relevant pollutants in these areas of interest are equal to or lower than the NAAQS, the project would demonstrate that Clean Air Act conformity requirements for the hotspot analysis are met.

The CO hotspot analysis for conformity purposes will also serve as the analysis for NEPA. While the conformity regulations only require the analysis of a preferred alternative (and the No-Action Alternative if the preferred alternative violates the NAAQS), the CO hotspot analysis includes all of the alternatives for NEPA purposes.

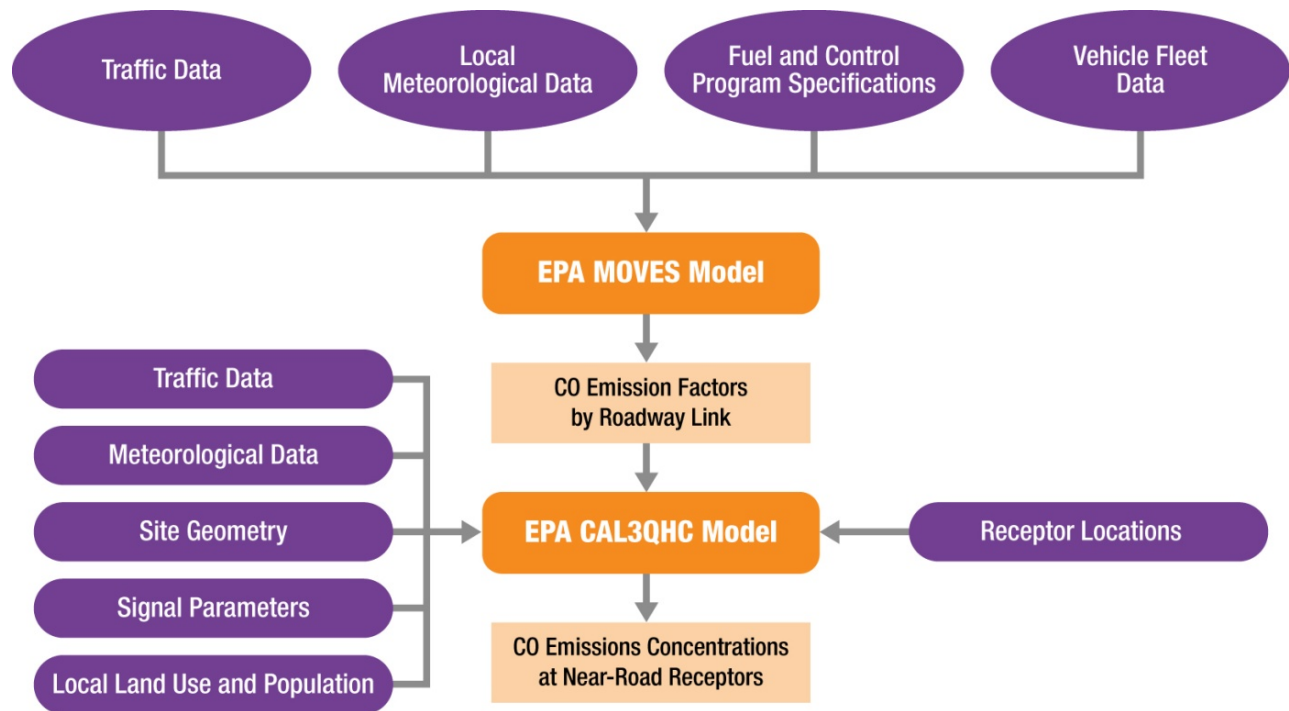
#### **4.3.1. Approach, models, and data**

EPA’s guidance and reference documents cited previously were used to establish the overall approach, modeling input data, and other assumptions for the CO hotspot analysis.

#### **Overview of the modeling process**

Figure 3 shows the modeling process used for this quantitative CO hotspot analysis.

**Figure 3. Modeling process for the CO hotspot analysis**



Traffic data in the form of future traffic volumes, vehicle miles of travel (VMT), and travel speeds from the DRCOG Compass regional travel demand model simulates the activities that generate emissions from on-road motor vehicles. For this Supplemental Draft EIS, the following project alternatives were modeled with Compass:

- 2035 No-Action Alternative
- 2035 Revised Viaduct Alternative, General-Purpose (GP) Lanes Option
- 2035 Revised Viaduct Alternative, Managed Lanes (ML) Option
- 2035 Partial Cover Lowered (PCL) Alternative, Basic Option with GP Lanes
- 2035 PCL Alternative, Basic Option with Managed Lanes (ML)
- 2035 PCL Alternative, Modified Option with ML

The No-Action Alternative and Revised Viaduct Alternative both have options that shift I-70 south or north. These shifts have no impact on traffic circulation and are each considered a single alternative for the purpose of projecting traffic, congested speeds, and emissions for all of the alternatives.

Local meteorological conditions, fuel specifications, and emissions control programs are input into the MOVES2010b Motor Vehicle Emissions Simulator model, in addition to the travel model results. The MOVES model uses this information to estimate on-road mobile-source (i.e., vehicle) emissions.

Emissions rates produced by MOVES are then fed into the CAL3QHC air quality dispersion model. CAL3QHC estimates localized ambient CO concentrations at receptors in and near the hotspot intersection study area. In addition to MOVES emissions rates, CAL3QHC also uses local meteorological data and terrain features in its calculations. In short, CAL3QHC takes the CO emissions rates and travel information from vehicles operating on the local roads and highways, tracks the emissions as they flow through the air, and estimates maximum daily concentrations at near-road receptors in the project area. A persistence factor

is used by the CAL3QHC model to convert peak-hour emissions to peak periods so the results are comparable to the 8-hour CO standard.

### **CO emissions for the hotspot analysis**

This hotspot analysis is based on carbon monoxide exhaust emissions from on-road motor vehicles. CO emissions from other sources are included in the analysis through the use of background emissions, as discussed below.

### **Locations to model**

The intersection location(s) for the CO hotspot analysis were determined through the Interagency Consultation process. The Conformity Rule requires modeling of intersection locations that are or will be at level of service (LOS) D or worse. In the case of the I-70 project, this would be dozens of intersections. The 2008 Draft EIS included CO hotspot modeling for four worst-case intersections. For this Supplemental Draft EIS, the modeling effort was scaled back to one intersection. As stated in FHWA's online *Transportation Conformity Reference Guide*, "... screen tools can show that if a project passes using a conservative set of assumptions, then it would definitely pass a more rigorous test." In this case, the conservative set of assumptions includes modeling the worst case intersection location, emissions factor dataset, and travel assumptions.

The 2008 Draft EIS analysis yielded low CO design value concentrations of approximately 5 to 6 parts per million (ppm), as compared to the applicable 8-hour NAAQS standard of 9 ppm. Furthermore, CO emissions factors from the MOVES model are relatively lower than those from the MOBILE 6.2 model used in the 2008 Draft EIS; and CO emissions factors decrease over time due to fuel economy and technology improvements. Therefore, it is unlikely that a notable increase in intersection CO emission concentrations would occur in 2035 even with increasing vehicle miles of travel (VMT).

The 2008 Draft EIS found that the interchange at I-70 and Colorado Boulevard would have the highest CO concentrations in the project area for the build scenarios considered then. The alternatives evaluated in the Supplemental Draft EIS are expected to have similar impacts on speeds and traffic volumes to those in the 2008 Draft EIS. Thus, this location still is considered to represent the worst case within the project area and is the only location modeled as part of the CO hotspot analysis. With the forthcoming DynusT mesoscopic simulation model results, there is a possibility that the worst-case location could change. This will be monitored and a different location may be modeled as part of the Final EIS if warranted.

The modeling of only one location is an alternative methodology allowed under Section 93.123(a)(1) of the Conformity Rule with EPA Regional Administrator approval. The alternative approach was proposed through the Interagency Consultation process and approved by the EPA Regional Administrator in a letter to CDOT dated June 12, 2013, as required by the rule. The letter is contained in Appendix B.

### **Analysis years/year of peak emissions**

Section 93.116(a) of the Conformity Rule requires that CO hotspot analyses consider the full time frame of an area's transportation plan. According to FHWA's online *Transportation Conformity Reference Guide*, this is accomplished by analyzing the year(s) of peak emissions over the plan's horizon through 2035. If the CO concentrations in the year of peak emissions are lower than the NAAQS limits, then it can be assumed that no adverse impacts will occur in any years within the time frame of the plan.

Rather than perform traffic modeling and hotspot analyses for numerous years to determine the year of peak emissions, the effort was streamlined through the Interagency Consultation process and approved by the EPA Regional Administrator. In the streamlined approach, CDOT used the highest CO emissions factors—in this case, for the year 2010—and the 2035 VMT to represent a worst-case condition. With this approach, it is not necessary to analyze several years to determine the year of peak emissions. If the worst traffic conditions (e.g., highest traffic volumes, most congestion delay, highest travel times, etc.) and highest emission rates are modelled, then the resulting CO concentration is the highest that potentially could be experienced between 2010 and 2035. If the worst resulting concentration is less than the NAAQS, then all other less congested locations in the corridor could be expected to be lower than the NAAQS as well.

### **Season(s) to model**

Because CO violations have typically occurred in the winter in the Denver region and the maintenance plan for this pollutant addresses wintertime conditions, the winter season was modeled for the CO hotspot analysis.

### **Model selection**

As required by the Transportation Conformity Rule in Section 93.105(c)(1)(i), an emissions model and an air quality dispersion model were selected through the Interagency Consultation process. EPA's MOVES2010b Motor Vehicle Emissions Simulator model was selected for use at the project scale to estimate emissions for each roadway link in the CO hotspot study area. MOVES is the approved and recommended emissions model for CO hotspot analyses for conformity determinations (EPA-420-B-12-010).

EPA's CAL3QHC model was selected for the air dispersion analysis and estimation of pollutant concentrations at receptors in and around the CO hotspot study area. It is the recommended model for use in CO hotspot screening analyses. CAL3QHC combines a steady-state dispersion model with a traffic model to calculate delays and queues at signalized intersections. CAL3QHC is one of the approved and recommended air dispersion model for analyzing CO impacts at intersections (Appendix W to 40 CFR Part 51, §5.2.3).

### **Traffic data**

The DRCOG regional travel demand model used for this CO hotspot analysis is the most recent version of Compass. The roadway networks in Compass include arterials, expressways, frontage roads, ramps, and freeways. Much of the collector street network in the region is also included. High-occupancy vehicle and high-occupancy tolled lanes are likewise included. Essentially, the only roads not included are local and residential streets and some collectors. Traffic volumes and speeds from the centroid connectors in the Compass model are used to represent travel on these local roads.

All alternatives have been modeled with sufficient information for projecting traffic, congested speeds, and emissions for all of the alternatives, as discussed in Chapter 3, Summary of Project Alternatives. Each link in the model's roadway network includes basic roadway information consisting of distance, number of lanes, roadway type (e.g., collector street, freeway), area type (e.g., central business district, urban, suburban, rural), tolls, and so forth. For the 2035 alternative model runs, the model provides forecasts of traffic volumes, congested speeds, and other information useful for long-range transportation planning and NEPA studies. Congested speeds are average speeds estimated by the model based on the amount of traffic and congestion on the link. All of these data are available for each link in the network.

### **Project-specific data**

In Section 93.123(c), the Transportation Conformity Rule requires that the CO hotspot analysis assumptions be consistent with the regional emissions analysis for conformity of the transportation plan and improvement program; and it suggests that project-specific data be used that are consistent with the major design features of the project. The data applied in this CO hotspot analysis are consistent with the assumptions used in the conformity determination for the regional transportation plan and improvement program. In addition, project-specific data—such as traffic volumes and site geometry—are consistent with the major design features of the project. Data sources and assumptions used in the CO hotspot analysis are included in the following sections for the MOVES and CAL3QHC models, respectively.

#### **4.3.2. Estimating on-road mobile vehicle CO emissions using MOVES**

EPA's MOVES2010b Motor Vehicle Emissions Simulator model was applied at the project scale to estimate emissions for each roadway link in the CO hotspot study area. MOVES is the approved and recommended model for CO hotspot analyses for conformity determinations (EPA-420-B-12-010).

#### **Overview of the MOVES modeling process**

The MOVES model uses several types of input data to generate either emissions factors or total emissions. Input data include vehicle types, fuel specifications, time periods, geographical information, vehicle operating

characteristics, meteorological data, fuel specifications, and inspection/maintenance program parameters, among others. MOVES includes default data for most of these items, but in most cases local data are used.

Section 2 of EPA's guidance (EPA-420-B-10-041) describes the following steps for estimating on-road motor vehicle emissions for this analysis using the MOVES model:

- Characterizing a project in terms of links
- Determining the number of MOVES runs
- Developing basic run specification inputs
- Entering project details using the Project Data Manager
- Generating emissions factors for use in air quality modeling

The following sections present the input data and assumptions used in the MOVES model for the CO hotspot analysis and the process for generating CO emissions and emissions factors. Specific input assumptions and sources are cited for the respective data items.

### **MOVES input data and assumptions**

This section identifies relevant data, sources, and assumptions used in the MOVES modeling for the CO hotspot analysis. The intent of this discussion is not to explain how the MOVES model works or how to run it but, rather, to document the assumptions used in running the MOVES model. Table 2 summarizes the option selections for the MOVES model. Table 3 summarizes the input data sources for the MOVES model used in the CO hotspot analysis. Subsequent sections describe the input data in more detail.

**Table 2. Summary of MOVES assumptions for the CO hotspot analysis**

No.	Item/Option	Assumption
1	Season to model	Winter quarter
2	Scale	Inventory
3	Time spans	8:00 a.m. to 9:00 a.m. for morning peak period 5:00 p.m. to 6:00 p.m. for evening peak period
4	Geographic bounds	Denver County
5	Vehicles, equipment, and fuel type	Fuel types: gasoline diesel Vehicle types: Motorcycle Passenger car Passenger truck Light commercial truck Refuse vehicle Motor home School bus Transit bus Intercity bus Single-unit long-haul truck Single-unit short-haul truck Combination long-haul truck Combination short-haul truck
6	Road type	Urban restricted access (i.e., freeway) Urban Unrestricted Access (i.e., non-freeway)
7	Pollutants and processes	Pollutant: Carbon monoxide Processes: Running exhaust Crankcase running exhaust
8	Output	General output: Mass units: grams Distance units: miles Activity: Distance traveled, Population Output emission detail: For all vehicle/equipment categories: Emission process

**Table 3. Summary of MOVES input data sources for the CO hotspot analysis**

No.	Data	Source
1	Meteorological data (temperature and humidity)	Denver International Airport weather station
2	Vehicle type and age distributions	Age distributions provided by APCD based on Colorado Department of Revenue data; consistent with CO State Implementation Plan
3	Fuel supply and formulation	Default MOVES data
4	Inspection and maintenance program	Local parameters supplied by APCD
5	Link source type	Calculated by CDOT from the traffic data used in the intersection analysis
6	Links	DRCOG Compass model

### Characterizing a project in terms of links

As described previously, the link traffic data were obtained from the DRCOG Compass models for the No-Action and Build Alternatives. The guidance (EPA-420-B-10-041) states that the goal of defining a project's links is "to accurately capture emissions where they occur." The Compass model does this by accurately simulating the geospatial features of the roadway system in a common coordinate system.

Each link represents a segment of road where a certain type of vehicle activity occurs. There are two types of links for this project: (1) free-flow links, and (2) queue links. Free-flow links represent vehicle activity on intersection approach and departure links. Each free-flow link in this project was defined using length, average speed, and traffic volume. Queue links represent vehicles idling at an intersection. Queue links were defined using traffic volume; link length is not relevant.

### Determining the number of MOVES runs

The number of MOVES model runs was established through the Interagency Consultation process. Traffic and meteorological conditions change by time of day, day of week, and month. The number of unique MOVES runs necessary to conduct the CO hotspot analysis is:

$$\text{Number of MOVES runs} = (2 \text{ peak time of day periods}) \times (2 \text{ link types}) \times (1 \text{ quarter}) \times (4 \text{ alternatives}) = 16 \text{ runs}$$

Historical CO monitoring data indicate that CO violations are only expected to occur in the winter months in the project area; therefore, only the winter quarter was modeled. As previously described, the MOVES runs should reflect worst-case conditions. For this project, peak emissions were captured using 2010 emissions factors with 2035 traffic data. Traffic data were defined for the morning and evening peak traffic periods in the Compass model for four of the alternatives being considered. For this Supplemental Draft EIS, the following project alternatives were modeled with Compass:

- 2035 No-Action Alternative
- 2035 Revised Viaduct Alternative, General-Purpose (GP) Lanes Option
- 2035 Revised Viaduct Alternative, Managed Lanes (ML) Option
- 2035 Partial Cover Lowered (PCL) Alternative, Basic Option with GP Lanes
- 2035 PCL Alternative, Basic Option with Managed Lanes (ML)
- 2035 PCL Alternative, Modified Option with ML

General Purpose Lanes were not modeled for the Partial Cover Lowered Alternative, Modified Option. The No-Action Alternative and Revised Viaduct Alternative both have options that shift I-70 south or north. These shifts have no impact on traffic circulation and are each considered a single alternative for the purpose of projecting traffic, congested speeds, and emissions for all of the alternatives.

### **Developing basic run specification inputs**

MOVES requires a run specification that defines the place and time of the analysis, as well as the vehicle types, road types, fuel types, and the emission-producing processes and pollutants that will be included in the analysis (EPA-420-B-10-041). The run specification identifies the data input options for the MOVES runs. Appendix C contains detailed information about the MOVES run specifications for the CO hotspot analysis.

### **Entering project details using the Project Data Manager**

After preparing the run specification, the next step is to create the appropriate input tables that describe the project in detail. Each MOVES run must have an accompanying set of input database tables that are imported into the model with the Project Data Manager. The following types of tables can be imported:

- Meteorology
- Age distribution
- Fuel supply
- Fuel formulation
- Inspection and maintenance programs
- Link source type
- Links
- Link drive schedule
- Operating mode distribution
- Off network

For this CO screening analysis of an intersection without any off-network links, not all of the importers were used. Specifically, this analysis did not import a link drive schedule, operating mode distribution, or off-network table for the screening analysis as all of the activity is defined through the average speed function of the Links input.

The MOVES input databases and data sources for the CO hotspot analysis are described in Appendix D.

### **4.3.3. CAL3QHC air dispersion modeling of CO emissions**

This description of the CAL3QHC modeling process is based in part on the EPA's *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections* (EPA-454/R-92-006R, Revised, September 1995).

#### **Overview of the CAL3QHC modeling process**

CAL3QHC calculates air quality concentrations based on the emission rates from the MOVES model, volume of traffic on each link from the DRCOG Compass model, and other factors. It generates distance-based emissions for moving vehicles and time-based emissions for idling vehicles for the roadway links in the CO hotspot study area around I-70 and Colorado Boulevard. Moving vehicles are simulated on free-flow links and idling vehicles are simulated using queue links in the model.

The required information from MOVES is an emission rate in grams per vehicle-mile for each free-flow link and an emission rate in grams per vehicle-hour for each queue link. For the free-flow links in CAL3QHC, the emissions were summed for all relevant pollutant processes then divided by the vehicle-miles of travel to obtain the desired emissions factors. The process is similar for the queue links. All relevant pollutant

processes are summed together then divided by the vehicle hours of travel on the link to obtain the desired emission rates.

The model also uses meteorological data, land use and population data, traffic data, traffic signal timing parameters, and intersection geometry to estimate maximum CO concentrations at near-road receptor locations. The receptor locations are another input to the CAL3QHC model. A persistence factor is used by the CAL3QHC model to convert peak-hour emissions to peak periods so the results are comparable to the 8-hour CO standard.

### CAL3QHC input data

This section describes the input data for the CAL3QHC model. The model relies primarily on locally obtained data. Table 4 summarizes the data and sources, which are described in more detail in the following sections.

**Table 4. Summary of CAL3QHC data and sources**

No.	Data	Source
1	Meteorological data	Denver International Airport weather station
2	Upper-air data describing vertical temperature and wind profiles	Denver International Airport weather station
3	Intersection geometry	CDOT
4	Receptor locations	CDOT, based on EPA's <i>CAL3QHC User's Guide</i> requirements
5	Traffic volumes	DRCOG Compass regional travel demand model
6	Traffic signal operational parameters	CDOT
7	CO emissions factors	CDOT, MOVES

### CO emissions factors

The composite running emissions factor for each free-flow link and the idle emissions factor for each queue link were obtained from the MOVES model. Each link in the model has its own emissions factor.

### Traffic data

Traffic volumes were obtained for the 2010 and 2035 No-Action Alternative and 2035 Build Alternatives from the DRCOG Compass regional travel demand model.

### Meteorological data

To support the air quality dispersion modeling with CAL3QHC, the following project-specific data were obtained from the Denver International Airport weather station:

- Surface meteorological data from monitors that measure the atmosphere near the ground
- Upper-air data describing the vertical temperature profile of the atmosphere
- Worst case wind speed
- Wind direction range
- Worst case stability class
- Mixing height
- Background concentrations
- Surface roughness length

The following meteorological data were used in the CAL3QHC model:

- Averaging time (min): 60
- Surface Roughness (cm): 175
- Settling Velocity (cm/s): 0
- Deposition Velocity (cm/s): 0
- Persistence Factor: 0.7
- Transport Wind Speed (m/s): 5
- Stability Class: 4
- Mixing Height (m): 1,000

### **Site geometry and link data**

Free-flow and queue links are defined using X, Y, and Z coordinates to represent roadways within the I-70/Colorado Boulevard CO hotspot study area. The intersection and roadway configurations are based on roadway designs from CDOT. Specific details of the intersection geometry used in the model include the intersection configuration and lane widths.

Each queue and free-flow link was entered as a discrete link in the model. For each link, the starting and ending coordinates were entered. The traffic volume, emissions factor, number of travel lanes, total cycle length, red signal cycle length, and saturation flow length were also entered for each link.

### **Traffic signal operational parameters**

Traffic signal parameters used in the CAL3QHC model include average signal cycle length, average red signal time length at each intersection approach, clearance lost time, vehicle saturation flow, signal type (pre-timed, actuated or semi-actuated), and arrival rate (worst, below average, average, above average, or best progression). These were provided by CDOT.

### **Receptor locations**

Receptor locations were distributed around the intersection where CO emission concentrations are estimated. Receptor locations are defined on the same X-Y-Z coordinate system as the site geometry. The receptor locations are defined by the analyst. EPA's CAL3QHC user's guide specifies a minimum distance of 10 feet from the outside edge of the road and a recommended height of 1.8 meters based on the average standing human height. For each alternative analyzed, the primary axis of each signalized intersection was surrounded by a series of 24 receptors placed 10 feet from the pavement edge.

#### **4.3.4. Background concentrations**

This hotspot analysis uses background CO concentrations from ambient monitoring data. The background CO concentration value of 3.0 ppm was provided by CDPHE/APCD.

### **4.4. PM<sub>10</sub> hotspot methodology**

A quantitative PM<sub>10</sub> hotspot analysis was prepared to address community and government agency concerns about PM<sub>10</sub> concentrations associated with the I-70 East project. This hotspot analysis is based on the requirements in the Transportation Conformity Rule and EPA's conformity guidance for quantitative particulate matter hotspot analyses (EPA-420-B-13-053). They describe the process and requirements: (1) for determining whether a project is of air quality concern, and (2) for meeting the NAAQS for PM<sub>10</sub> if an analysis is applicable. The conformity determination for PM<sub>10</sub> will be made as part of the Final Environmental Impact Statement (FEIS), so the PM<sub>10</sub> hotspot analysis was prepared to meet transportation conformity requirements.

In addition to the conformity rule, an EPA memorandum (*Using MOVES and EMFAC Emissions Models in NEPA Evaluations*, Bromm, Feb. 8, 2011) provides guidance for the PM<sub>10</sub> hotspot analysis by recommending that the same model be used in NEPA documents as is used for determining transportation conformity to maximize coordination and minimize confusion.

The Denver region is an attainment/maintenance area for the pollutant PM<sub>10</sub>. Because of this, the project must meet project-level conformity requirements. Although the Supplemental Draft EIS is not determining project-level conformity, the analysis was conducted in lieu of any other viable quantitative methodologies to evaluate air quality impacts.

As defined in Section 101 of the Transportation Conformity Rule, a quantitative "... hotspot analysis is an estimation of likely future localized ... pollutant concentrations and a comparison of those concentrations to the national ambient air quality standards." A hotspot analysis is conducted for specific locations, such as congested roadway intersections. It uses an on-road mobile emissions model in combination with an air quality dispersion model to determine design values that represent local PM<sub>10</sub> pollutant concentrations at near-road receptor locations. The modeled pollutant concentrations then are compared to the NAAQS limits.

When the conformity tests are applied, the project would demonstrate that Clean Air Act conformity requirements are met as long as the modeled PM<sub>10</sub> concentrations, or design values, are equal to or lower than the NAAQS.

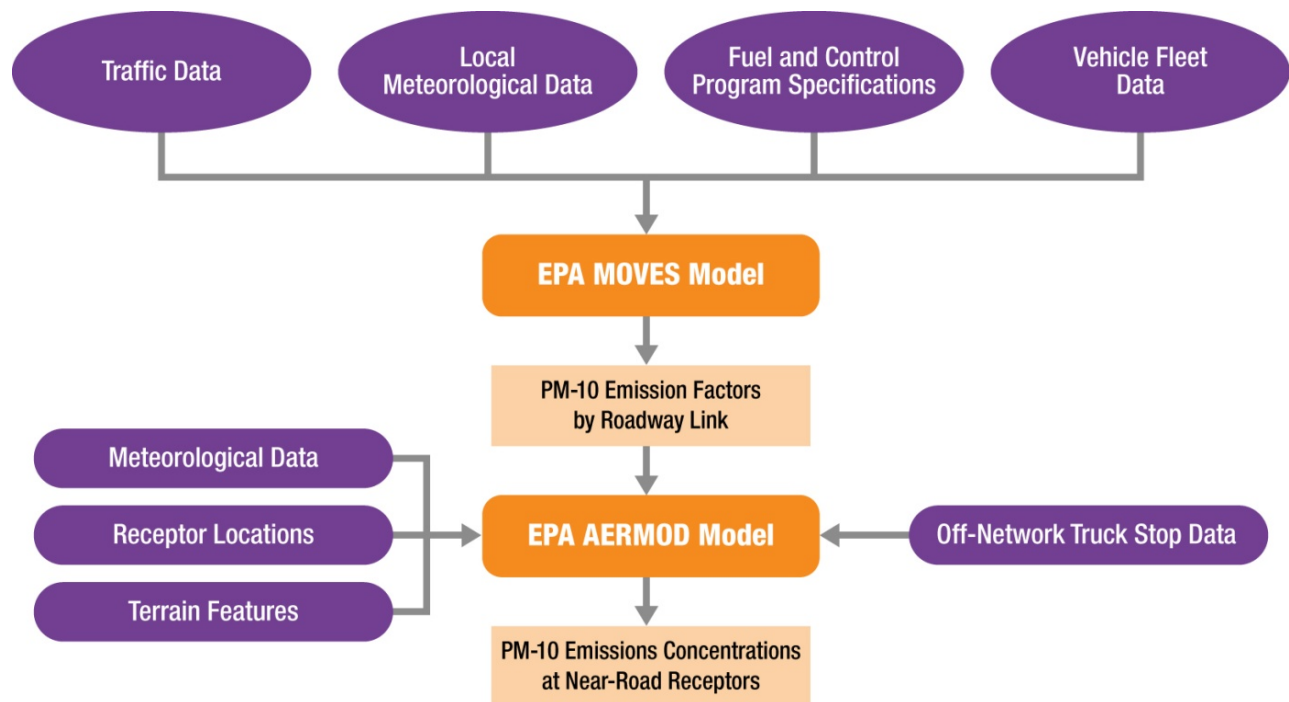
#### 4.4.1. Approach, models, and data

EPA's guidance and reference documents cited previously were used to establish the overall approach, modeling input data, and other assumptions for the PM<sub>10</sub> hotspot analysis.

##### Overview of the modeling process

Figure 4 shows the modeling process used for this quantitative PM<sub>10</sub> hotspot analysis.

**Figure 4. Modeling process for the PM<sub>10</sub> hotspot analysis**



Traffic data in the form of future traffic volumes, vehicle miles of travel, and travel speeds from the Denver Regional Council of Government's Compass regional travel demand model simulates the activities that generate emissions from motor vehicles. For this Supplemental Draft EIS, the following project alternatives were modeled with Compass:

- 2035 No-Action Alternative
- 2035 Revised Viaduct Alternative, General-Purpose (GP) Lanes Option
- 2035 Revised Viaduct Alternative, Managed Lanes (ML) Option
- 2035 Partial Cover Lowered (PCL) Alternative, Basic Option with GP Lanes
- 2035 PCL Alternative, Basic Option with Managed Lanes (ML)
- 2035 PCL Alternative, Modified Option with ML

The General-Purpose Lanes Option was not modeled for the Partial Cover Lowered Alternative, Modified Option. The No-Action Alternative and Revised Viaduct Alternative both have options that shift I-70 south or north. These shifts have no impact on traffic circulation and are each considered a single alternative for the purpose of projecting traffic, congested speeds, and emissions for all of the alternatives.

Local meteorological conditions, fuel specifications, and emissions control programs were input into the MOVES2010b Motor Vehicle Emissions Simulator model, in addition to the travel model results. The MOVES model used this information to estimate on-road mobile-source (i.e., vehicle) emissions.

Emissions rates produced by MOVES are then fed into the AERMOD air quality dispersion model. AERMOD estimates localized ambient PM<sub>10</sub> concentrations at receptors in and near the two hotspot locations chosen for the study. In addition to MOVES emissions rates, AERMOD also uses local meteorological data and terrain features in its calculations; terrain features did not include differences in elevation between the ground and the roadway. In short, AERMOD takes the PM<sub>10</sub> emissions rates and vehicle miles of travel from vehicles operating on the local roads and highways, truck idling activity at the off-network truck stop, and the emission factors from the covered highway (as applicable). AERMOD then tracks the emissions as they flow through the air for a daily (24-hour) time period, and estimates maximum daily concentrations at receptors in the project area.

### **PM<sub>10</sub> emissions for the hotspot analysis**

Through the Interagency Consultation process, the agencies agreed that a quantitative PM<sub>10</sub> hotspot analysis would be conducted to calculate design values at receptors in the areas around the locations of interest for the No-Action and Build Alternatives. The PM hotspot analysis includes PM<sub>10</sub> emissions from on-road mobile sources and from an off-highway truck stop located at the northeast corner of I-70/46<sup>th</sup> Avenue and Vasquez Boulevard/Steele Street. The truck stop is a source of potentially significant PM<sub>10</sub> emissions. It is modeled as an off-network link in MOVES and an area source in AERMOD. The following list summarizes the emissions included and not included in this PM<sub>10</sub> hotspot analysis:

- Exhaust, brake wear, and tire wear emissions from on-road vehicles are included in this analysis.
- Re-entrained road dust kicked up into the air by passing vehicles was included in this PM<sub>10</sub> hotspot analysis. Road dust is a significant component of PM<sub>10</sub> emissions from mobile sources.
- Emissions from construction-related activities were not required and, therefore, not included in this PM<sub>10</sub> hotspot analysis since these emissions are considered temporary, as defined in 40 CFR 93.123(c)(5). Temporary increases in PM<sub>10</sub> emissions due to construction-related activities are defined in the regulation as those occurring only during construction that last five years or less at any given site.

### **Locations to model**

The geographic area to be covered by the PM<sub>10</sub> hotspot analysis was determined through the Interagency Consultation process. It was agreed that rather than analyzing all on-road interchange locations across the

entire project area, it would be appropriate to focus the PM<sub>10</sub> hotspot analysis at two locations that were expected to have the highest concentrations. Considerations for locations with the highest concentrations include areas with the highest traffic volumes and congestion, nearby land uses with public access, high numbers of diesel vehicles, and other factors. The highest volume locations in the project area are associated with major interchanges. The major interchanges and their 2035 traffic forecasts from the DRCOG Compass model run are listed in Table 5. The forecasted volumes for the other alternatives are similar.

**Table 5. Interchange traffic volumes (2035)**

Interchange	2035 Annual Average Daily Traffic
I-70/I-25	~475,000
I-70/I-270	~390,000
I-70/I-225	~415,000
I-70/Peña Boulevard	~330,000

Source: DRCOG 2035 Compass Model

The I-70/I-270 and I-70/Peña Boulevard interchanges have high traffic volumes but no nearby land uses with public access. Therefore, emissions would be anticipated to be lower at the closest public access receptors to these two locations than they would at the I-70/I-25 and I-70/I-225 interchanges, which have nearby land uses with public access. The I-70/I-25 interchange is just outside of the project limits, but upwind of the project area under some conditions. As the figures in Table 1 indicate, the interchanges of I-70 with I-25 and I-225 have higher traffic volumes than the other two locations. Furthermore, background concentrations are expected to be very similar at the four locations based on the proximity of nearby PM<sub>10</sub> monitors.

Considering these factors, two interchange locations were selected for the analysis:

1. The I-70/I-25 interchange area from I-25 to the Vasquez Boulevard/Steele Street interchange
2. The area around the I-70/I-225 interchange

### Season(s) to model

Because PM<sub>10</sub> violations have typically occurred in the winter in the Denver region and the maintenance plan for this pollutant addresses wintertime conditions, the winter season was modeled. As required by EPA guidance 420-B-10-040, "... it is important to conduct modeling for those parts of an analysis year where PM concentrations are expected to be highest." This was verified through the Interagency Consultation process, as well as from the local PM<sub>10</sub> monitoring data.

### Model selection

As required by the Transportation Conformity Rule (40 CFR 93.105(c)(1)(i)), an emissions model and an air quality dispersion model were selected through the Interagency Consultation process. EPA's MOVES2010b Motor Vehicle Emissions Simulator model was selected for use at the project scale to estimate emissions for each roadway link in the PM<sub>10</sub> hotspot locations. EPA's AERMOD model (Version 12345) was selected through Interagency Consultation for the air dispersion analysis and estimation of pollutant concentrations at receptors in the local near-road land areas. AERMOD can model closure of the truck stop in the corridor affected by some of the alternatives, and it can also model the outflow from the proposed covered portion of I-70.

### Project-specific data

The Transportation Conformity Rule requires that the most recent planning assumptions be used for a conformity determination of regional transportation plans and transportation improvement programs (40 CFR

93.110). The regulation also states that a hotspot analysis must use assumptions that are consistent with the current regional conformity determination.

EPA's guidance (EPA-B-10-040, 3.3.7) further specifies that project-specific data be used when possible. Project-specific data refers to information related directly to the corridor and/or proposed project rather than default values from the MOVES model.

Data sources and assumptions used in the PM<sub>10</sub> hotspot analysis are included in the following sub-sections. The requirements related to the data item are summarized from the descriptions in EPA guidance (EPA-B-10-040, 3.3.7).

### **Traffic data**

Traffic data used in the PM<sub>10</sub> hotspot analysis was sufficient to characterize each link in the project area. The primary link traffic data were obtained from the DRCOG model runs for the No-Action and Build Alternatives. The 2035 No-Action model is consistent with the model, network, and other assumptions used for the conformity determination of the regional transportation plan and transportation improvement program.

The DRCOG regional travel demand model used for this PM<sub>10</sub> hotspot analysis is the most recent version of Compass. The roadway networks in Compass include arterials, expressways, frontage roads, ramps, and freeways. Much of the collector street network in the region is also included. High-occupancy vehicle and high-occupancy tolled lanes are likewise included. Essentially, the only roads not included are local and residential streets and some collectors.

Each link in the model's roadway network includes basic roadway information such as distance, number of lanes, roadway type (e.g., collector street, freeway), area type (e.g., central business district, urban, suburban, rural), tolls, and others. For the 2035 alternative model runs, the model provides forecasts of traffic volumes, congested speeds, and other information useful for long-range transportation planning and NEPA studies. Congested speeds are average speeds estimated by the model based on the amount of traffic and congestion on the link. All of these data are available for each link in the network.

### **Starts per hour and vehicle idling at the Pilot Travel Center**

In addition to on-road, link-based mobile sources (cars, trucks, etc.), the PM<sub>10</sub> hotspot analysis includes an off-highway truck stop located at the northeast corner of I-70/46<sup>th</sup> Avenue and Vasquez Boulevard/ Steele Street. The Pilot Travel Center truck stop is a source of potentially significant PM<sub>10</sub> emissions. It is modeled as an off-network link in MOVES and as an area source in AERMOD. Figure 5 shows an aerial view of the truck stop location.

**Figure 5. Pilot Travel Center aerial view**

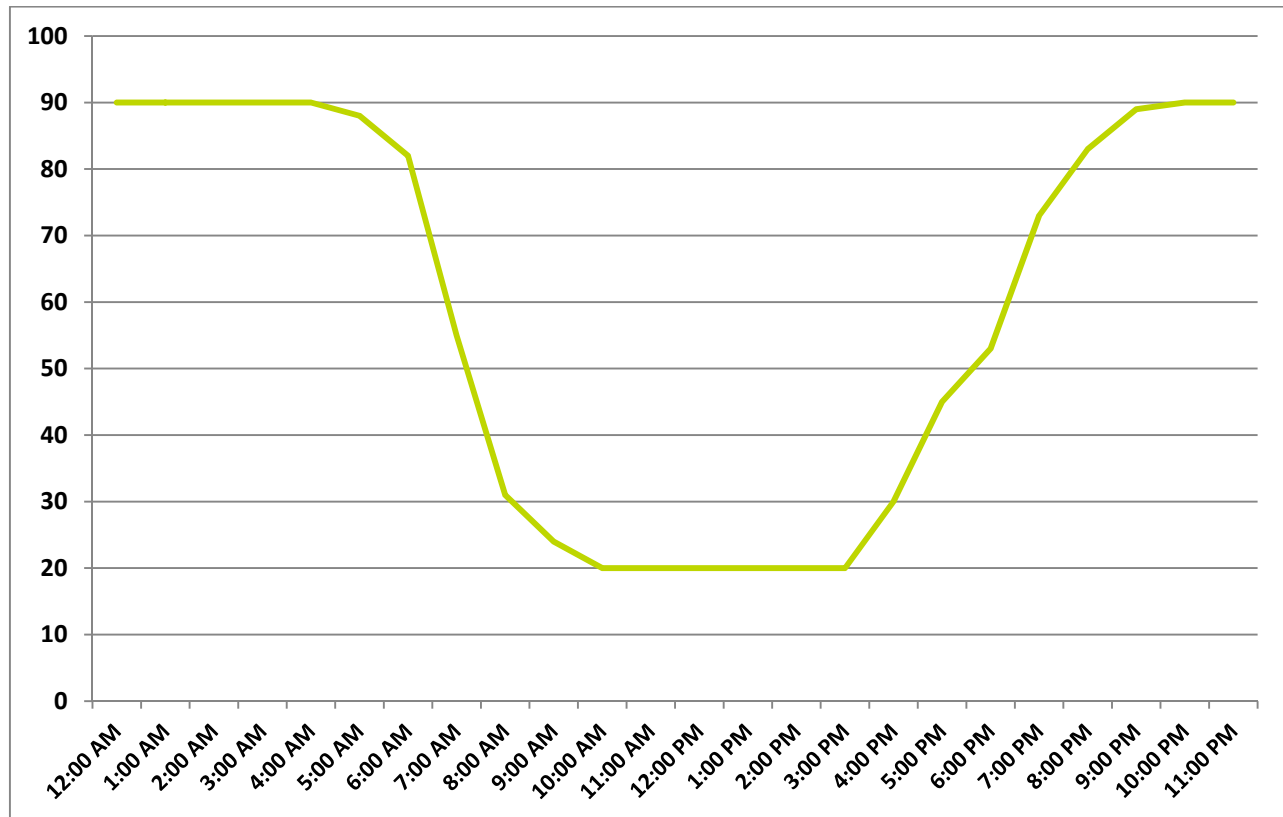


The Pilot Travel Center is proposed to be closed as part of the Partial Cover Lowered Alternative and Revised Viaduct Alternative, North Option because the land is needed to accommodate the alternatives' footprints. Thus, it became important to understand the diesel truck idling activity at the truck stop during the winter months to support the analysis so the associated emissions could be subtracted from results for the appropriate alternatives.

A review of aerial photos and initial informal surveys and interviews provided the following estimates of activity at the truck stop:

- The truck stop has spaces for approximately 90 rigs to park overnight.
- The truck stop parking lot was full at 5:00 a.m. during a typical weekday in January.
- Very little movement occurred from 5:00 a.m. to 5:45 a.m. Two small activity peaks occurred between 5:45 a.m. and 7:00 a.m. and between 7:30 a.m. and 8:45 a.m.
- For winter months on a typical weekday, the number of trucks is 90 (lot 100% full).
- Auxiliary power unit (APU) use is estimated at zero (0%).
- Diesel engine idling is estimated at 100% if the average temperature is below 32 degrees Fahrenheit; and it is estimated at zero (0%) otherwise.
- The minimum number of trucks in the parking lot during the winter weekday day is estimated to be 20. Based on driver input, their departure time depends on the location and timing of their shipment pickup or drop-off.
- The use/vacancy curve is estimated as shown in Figure 6. This information was used to estimate the starts per hour.

**Figure 6. Estimated trucks in Pilot Travel Center parking lot**



Appendix B contains more detail on the data collection, research, and results associated with the Pilot Travel Center to support the  $PM_{10}$  hotspot analysis. No other off-network emission sources were modeled in the  $PM_{10}$  hotspot analysis.

### Roadside dust emissions

Dust from vehicle brakes, tires, and other mobile sources is a significant factor of particulate emissions within the project area. Roadside dust emissions are estimated to contribute up to 80 percent and 90 percent of the total daily  $PM_{10}$  emissions at the two hotspot locations. MOVES does not calculate PM emissions from road dust. To estimate road dust and sanding emissions for this analysis, emissions factors from the most recent  $PM_{10}$  maintenance SIP were compared with control factors currently achieved by CDOT.

Emissions factors included in the SIP vary with road type and jurisdiction maintaining the road. However, within the project area, CDOT currently uses increased sweeping and sanding control measures to reduce roadside dust emissions beyond the factors in the SIP. Project alternatives were evaluated with and without this program. At the I-25 hotspot location, the location with the highest  $PM_{10}$  design values, the comparison of particulate matter concentrations with and without the program shows that the existing maintenance program reduces total roadway  $PM_{10}$  concentrations by as much as 60 percent (Table 6). While all alternatives were modeled with and without road dust maintenance factors, for the purposes of NEPA evaluation, the results of the  $PM_{10}$  analysis include maintenance program benefits and values to include the existing sweeping program for all alternatives.

**Table 6. Total roadway PM<sub>10</sub> concentration comparison at I-25 Hotspot location – 6<sup>th</sup> highest values (µg/m<sup>3</sup>)**

Without existing dust control program					
Alternative	2007	2008	2009	2010	2011
No-Action	93	102	93	105	92
Revised Viaduct (GP)	58	65	59	71	61
Revised Viaduct (ML)	126	145	131	148	139
Partial Cover Lowered, Basic Option (GP)	75	86	77	90	81
Partial Cover Lowered, Basic Option (ML)	74	79	75	88	79
Partial Cover Lowered, Modified Option (ML)	93	93	99	112	109
Including existing dust control program					
Alternative	2007	2008	2009	2010	2011
No-Action	35	36	32	39	33
Revised Viaduct (GP)	47	51	45	57	49
Revised Viaduct (ML)	69	73	70	68	73
Partial Cover Lowered, Basic Option (GP)	54	58	56	60	60
Partial Cover Lowered, Basic Option (ML)	33	35	33	38	35
Partial Cover Lowered, Modified Option (ML)	66	65	73	78	80

### Vehicle type and age distribution

The vehicle type and age distributions were obtained from the Colorado Department of Revenue and are consistent with those used in the most recent conformity determination for the Denver region.

### Temperature and humidity

Temperature and humidity data used as inputs for the MOVES and AERMOD emission models were obtained from the Denver International Airport weather station and are consistent with the EPA'S guidance that meteorology data must be representative of the Denver region. Per EPA guidance, the same meteorology data were used in both the MOVES and AERMOD models.

### Other project-specific data

To support the air quality dispersion modeling with AERMOD, the following project-specific data were obtained:

- Surface meteorological data from monitors that measure the atmosphere near the ground from the Denver International Airport weather station
- Upper air data describing the vertical temperature profile of the atmosphere
- Land use data describing surface characteristics near the surface meteorological monitors
- Nearby population data from the U.S. Census
- Information necessary for determining locations of air quality modeling receptors

This information is not used in the regional conformity determination, so there is no consistency requirement for these data in that regard. However, the information was derived from local and/or national sources to represent local conditions.

#### **4.4.2. Analysis year/year of peak PM<sub>10</sub> emissions**

Section 93.116(a) of the Conformity Rule requires that PM<sub>10</sub> hotspot analyses consider the full time frame of an area's transportation plan. The EPA's quantitative PM hotspot guidance (EPA-420-B-13-053, November 2013) expands on this requirement by stating that the analysis should include the year(s) within the transportation plan during which peak emissions from the project are expected. The rule also describes the factors that should be considered when selecting the year(s) of peak emissions, including changes in vehicle fleets, traffic volumes, speeds, and VMT, as well as expected trends in background concentrations.

The analysis year of 2035 was selected through the Interagency Consultation process. However, the Interagency Consultation process also established the need to estimate the year of peak emissions through a comparison of emissions factors and VMT for several interim years. This analysis verified that 2035 is the year of peak emissions.

The year of peak emissions was determined through an aggregate estimation of emissions for every five years from 2010 through 2035. The EPA's MOVES model was run for each year to produce emissions factors in grams per mile. The emissions factors were multiplied by average weekday VMT for each year to produce an estimate of emissions for each interim year for comparison.

Based on the requirements, the regional transportation plan's horizon year of 2035 was modeled and an analysis was conducted to estimate emissions for 2010 and interim years of 2015, 2020, 2025, and 2030. Project completion is anticipated to occur after 2020. Three locations were reviewed in the year emissions analysis: (1) the air quality study area, (2) the I-70/I-25 PM<sub>10</sub> hotspot area, and (3) the I-70/I-225 PM<sub>10</sub> hotspot area.

Appendix C contains a detailed discussion of the input data, assumptions, and process for conducting the year of peak emissions analysis.

For road dust and road sanding emissions, calculation of emissions is complicated by the fact that the emissions factors used in the SIP are regional conformity vary by area type, road type, and road ownership (i.e., which agency is responsible for maintaining the road). Since the goal of this analysis is simply to document the trend in emissions, one average road dust emissions rate was used for the entire project area (unlike the actual hotspot analysis, where link-specific emissions rates were used). This rate was calculated using the VMT and controlled sanding and road dust emissions estimates from Section 3.4 of the PM<sub>10</sub> SIP Technical Support Document (TSD). Calendar year 2025 values were used (the last year of data in the TSD), and the resulting emissions rate is 0.616 grams per mile.

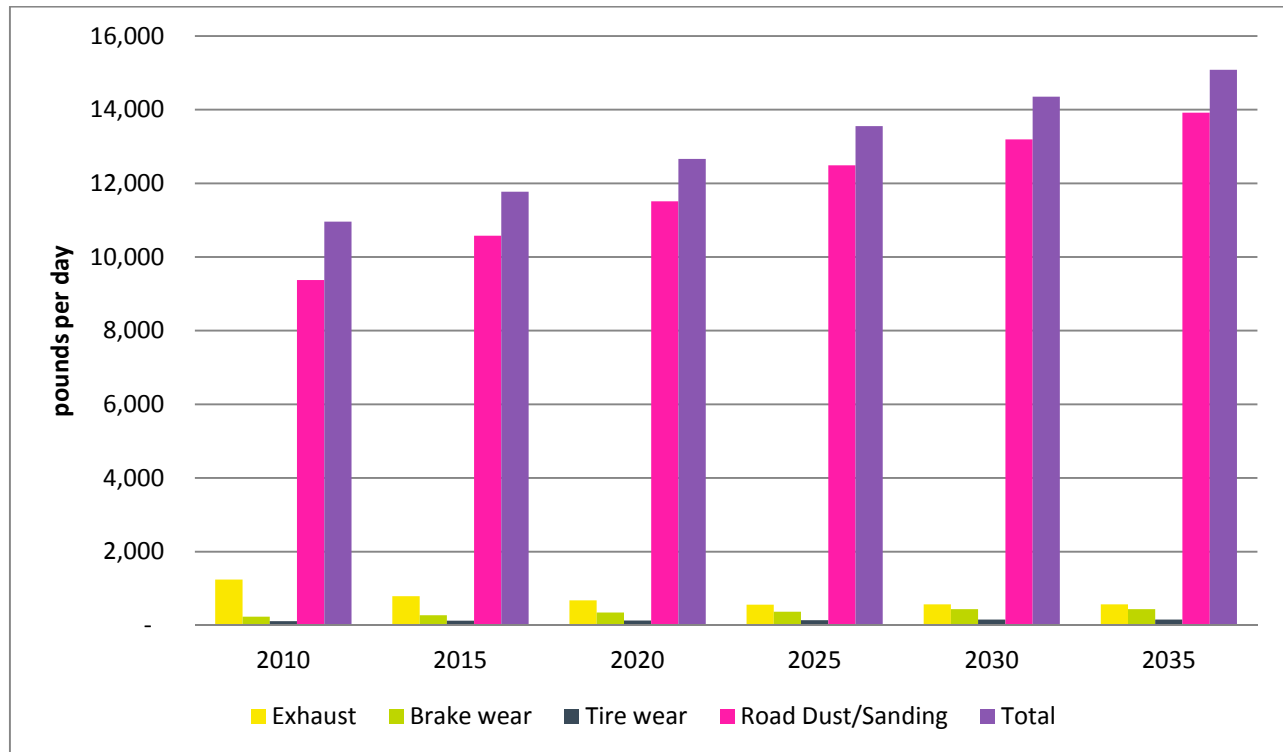
The results of the emissions estimates are shown in Table 7, Figure 7, Figure 8, and Figure 9. As the table and charts indicate, PM<sub>10</sub> emissions are highest in 2035 for the Study Area as a whole, as well as the I-70/I-25 and I-70/I-225 hotspot areas. Thus the year of peak emissions was estimated to occur in 2035, and it can be assumed that the concentration results would be similar as well.

The consideration of background PM<sub>10</sub> concentration trends further supports the use of 2035 as the year of peak emissions. In the CDPHE/APCD's *Colorado State Implementation Plan for PM<sub>10</sub>, Revised Technical Support Document* (September 2005), Table 5.1-1 shows a summary of maintenance year model demonstrations in which the sixth highest modeled concentration increases steadily from 2001 through at least 2030. Table 3.1-1 of that document also shows a steadily increasing total PM<sub>10</sub> emission inventory from 2001 through 2025. In that 2005 document, the analysis does not include 2035, but the evidence is clear, the overall PM<sub>10</sub> emission inventory is rising over time due to increases in almost all source types. Therefore, it is reasonable to conclude that the year 2035 is the year of peak emissions to model for the PM<sub>10</sub> hotspot analysis.

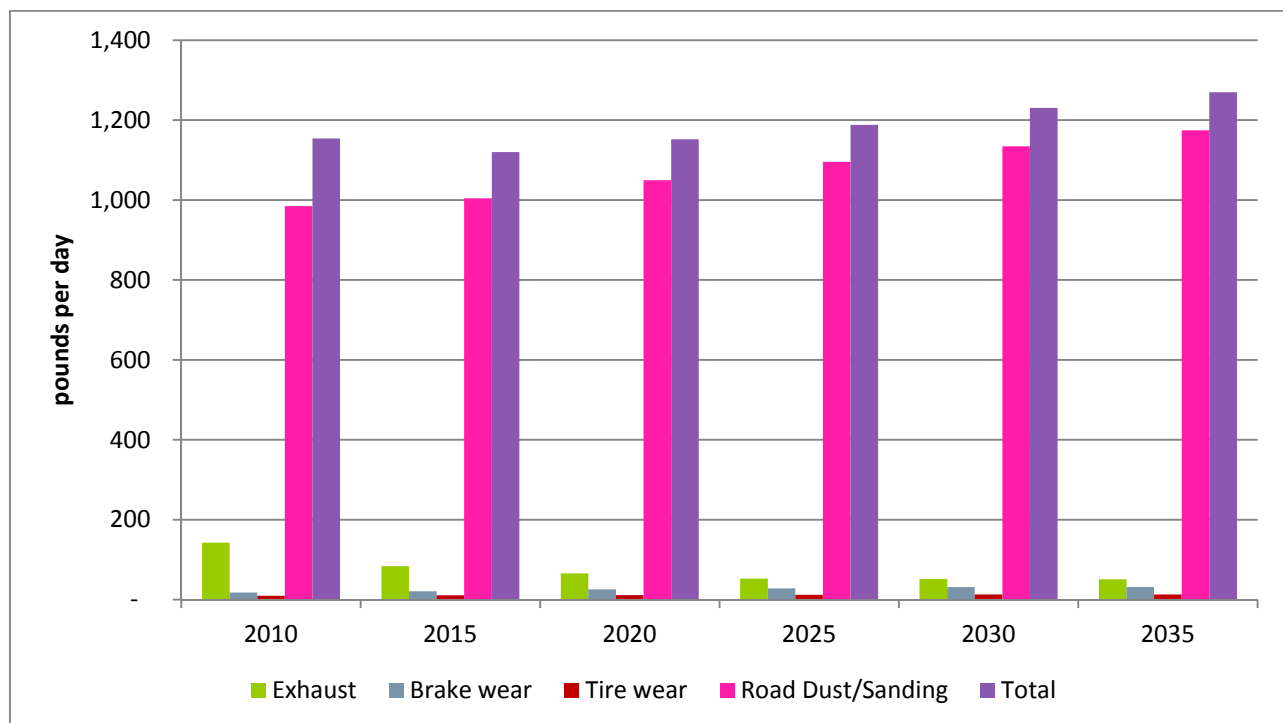
**Table 7. PM<sub>10</sub> emissions for peak year of emissions analysis (study area, pounds per weekday)**

Description	2010	2015	2020	2025	2030	2035
<b>Study Area</b>						
Freeway	5,745	5,886	6,176	6,525	6,849	7,181
Non-freeway	5,215	5,885	6,488	7,028	7,505	7,903
Total	<b>10,960</b>	<b>11,772</b>	<b>12,664</b>	<b>13,553</b>	<b>14,353</b>	<b>15,084</b>
<b>I-70/I-25 Hotspot Area</b>						
Freeway	878	825	844	872	904	935
Non-freeway	276	296	308	316	327	335
Total	<b>1,154</b>	<b>1,120</b>	<b>1,152</b>	<b>1,188</b>	<b>1,231</b>	<b>1,270</b>
<b>I-70/I-225 Hotspot Area</b>						
Freeway	173	180	198	218	231	245
Non-freeway	170	187	198	207	217	225
Total	<b>343</b>	<b>367</b>	<b>396</b>	<b>425</b>	<b>448</b>	<b>471</b>

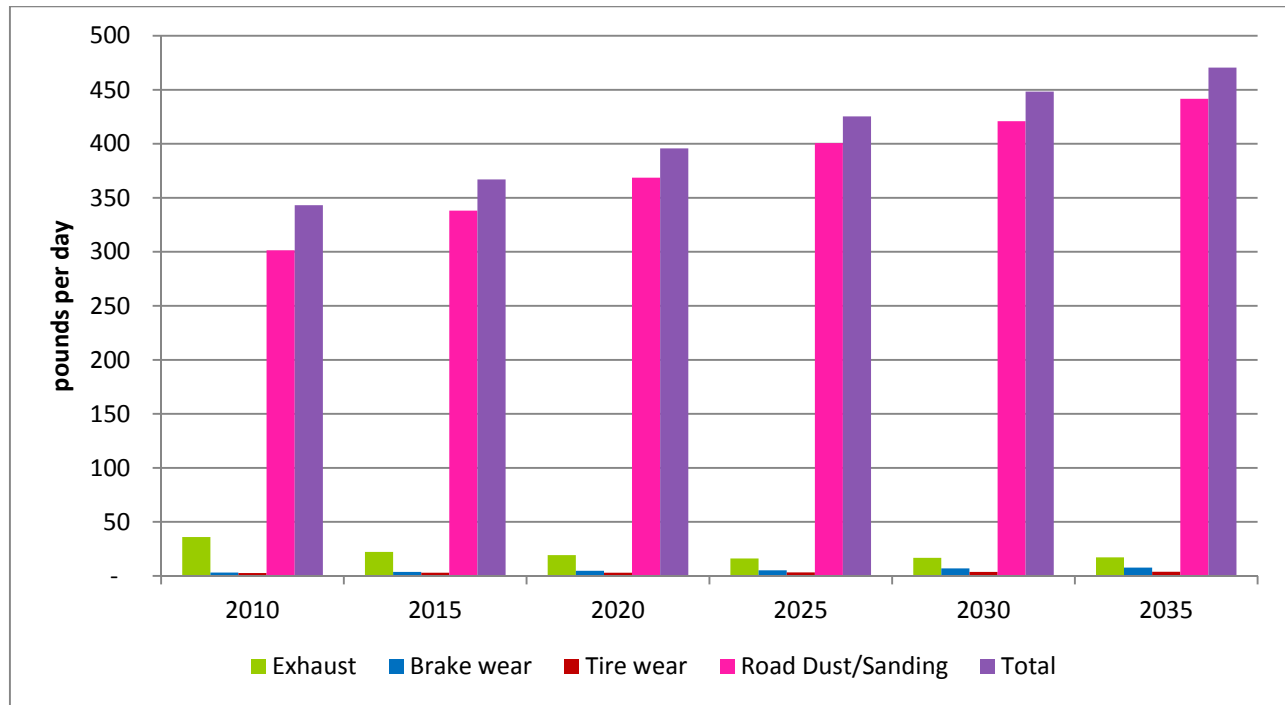
**Figure 7. PM<sub>10</sub> emissions for peak year of emissions analysis (study area, pounds per weekday)**



**Figure 8. PM<sub>10</sub> emissions for peak year of emissions analysis (I-70/I-25 hotspot area, pounds per weekday)**



**Figure 9. PM<sub>10</sub> emissions for peak year of emissions analysis (I-70/I-225 hotspot area, pounds per weekday)**



#### 4.4.3. Estimating on-road mobile vehicle PM<sub>10</sub> emissions using MOVES

##### MOVES input data and assumptions

Section 4 of EPA's guidance (EPA-420-B-13-053) describes the following steps for estimating on-road motor vehicle emissions for this analysis using the MOVES model:

- Characterizing a project in terms of links
- Determining the number of MOVES runs
- Developing basic run specification inputs
- Entering project details using the Project Data Manager
- Generating emissions factors for use in air quality modeling

This section identifies relevant data, sources, and assumptions used in the MOVES modeling for the PM<sub>10</sub> hotspot analysis. The intent of this discussion is not to educate about how the MOVES model works or how to run it. Instead, this discussion documents the assumptions used in running the MOVES model.

##### Characterizing a project in terms of links

As described previously, the link traffic data were obtained from the DRCOG Compass models for the No-Action and Action alternatives. The guidance (EPA-420-B-13-053) states that the goal of defining a project's links is "to accurately capture emissions where they occur." The Compass model does this by accurately simulating the geospatial features of the roadway system in a common coordinate system. Additionally, the Pilot Travel Center is modeled as an off-network link at the location where the emissions occur in the network.

### **Determining the number of MOVES runs**

Traffic and meteorological conditions change by time of day, day of week, and month. The number of unique MOVES runs necessary to conduct the PM<sub>10</sub> hotspot analysis is:

$$\text{Number of MOVES runs} = (4 \text{ time of day periods}) \times (1 \text{ quarter}) \times (6 \text{ alternatives}) = 24 \text{ runs}$$

Historical PM<sub>10</sub> monitoring data indicate that PM<sub>10</sub> violations are only expected to occur in the winter months in the project area; therefore, only the winter quarter was modeled. Traffic data were defined for the four weekday time periods in the Compass model: morning peak (AM), midday (MD), evening peak (PM), and overnight (ON). For this Supplemental Draft EIS, the following project alternatives were modeled with Compass:

- 2035 No-Action Alternative
- 2035 Revised Viaduct Alternative, General-Purpose (GP) Lanes Option
- 2035 Revised Viaduct Alternative, Managed Lanes (ML) Option
- 2035 Partial Cover Lowered (PCL) Alternative, Basic Option with GP Lanes
- 2035 PCL Alternative, Basic Option with Managed Lanes (ML)
- 2035 PCL Alternative, Modified Option with ML

The General-Purpose Lanes Option was not modeled for the Partial Cover Lowered Alternative, Modified Option. The No-Action Alternative and Revised Viaduct Alternative both have options that shift I-70 south or north. These shifts have no impact on traffic circulation and are each considered a single alternative for the purpose of projecting traffic, congested speeds, and emissions for all of the alternatives.

### **Developing basic run specification inputs**

MOVES requires a run specification that defines the place and time of the analysis, as well as the vehicle types, road types, fuel types, and the emission-producing processes and pollutants that will be included in the analysis (EPA-420-B-13-053). Appendix D contains detailed information about the run specifications for the MOVES model.

### **Entering project details using the Project Data Manager**

After preparing the run specification, the next step is to create the appropriate input tables that describe the project in detail. Each MOVES run must have an accompanying set of input database tables that are imported into the model with the Project Data Manager. The following types of tables can be imported:

- Meteorology
- Age distribution
- Fuel supply
- Fuel formulation
- Inspection and maintenance programs
- Link source type
- Links
- Link drive schedule
- Operating mode distribution
- Off network

The input database tables that contain this information are described in Appendix E.

### **Generating emissions factors**

The MOVES model provides results as either an emission total (if “Inventory” is selected) or an emissions factor (if “Emission Rates” is selected). AERMOD uses a grams/hour emissions factor for each hour of the day. For the hotspot analysis, the Inventory option was selected so MOVES produced output in the format needed by AERMOD. Aggregate PM emissions in units of grams/hour were then calculated by summing the appropriate pollutants over the roadway network links.

#### **4.4.4. Estimating emissions from road dust, construction, and additional sources**

As previously stated, re-entrained road dust kicked up into the air by passing vehicles was included in this PM<sub>10</sub> hotspot analysis. Road dust is a significant component of PM<sub>10</sub> emissions from mobile sources. The EPA requires road dust emissions to be included in all conformity analyses of PM<sub>10</sub> emissions, including hotspot analyses (EPA-420-B-13-053-6.3.2). MOVES does not calculate PM emissions from road dust. To estimate road dust and sanding emissions for this analysis, the emissions factors from the most recent PM<sub>10</sub> conformity modeling were used. Each link was assigned an emissions factor based on road type, control program and maintaining agency.

#### **4.4.5. AERMOD air dispersion modeling of PM<sub>10</sub> emissions**

##### **Air quality model selection**

Through the Interagency Consultation process, it was determined that AERMOD was the most appropriate model to use in this PM<sub>10</sub> hotspot analysis. The American Meteorological Society/EPA Regulatory Model (AERMOD) is EPA’s recommended near-field dispersion model for many regulatory applications. EPA recommended AERMOD in a November 9, 2005, final rule (40 CFR Part 51, *Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose Dispersion Model and Other Revisions*, Federal Register, Volume 70, No. 216) that amended EPA’s “Guideline on Air Quality Models” after more than 10 years of development and peer review, which resulted in substantial improvements and enhancements. AERMOD includes options for modeling emissions from volume, area, and point sources, so it can model the impacts of the truck stop and the PCL Alternatives.

### **Characterizing emission sources**

#### **Physical characteristics and location**

Using spatial analysis in a geographic information systems (GIS) environment, the physical characteristics and location of the emission sources were translated into AERMOD’s input format. For this analysis, the highway and intersection links in MOVES were represented as Area Sources in AERMOD.

#### **Emission rates/emissions factors**

The magnitude of emissions within a given time period or location is a necessary component of dispersion modeling. MOVES-generated emission rates were utilized for AERMOD. Each MOVES link is represented by one or more sources in AERMOD.

#### **Temporal and seasonal assumptions**

The proper description of emissions by time of year, day of week, and hour of day is critical to the utility of air quality modeling. Air quality modeling for the 24-hour PM<sub>10</sub> NAAQS in this circumstance only involves modeling one quarter of the year over the winter months for five years. For this PM<sub>10</sub> hotspot analysis, an hourly emissions factor was generated for each alternative for use in AERMOD.

### **Meteorological data inputs**

For this PM<sub>10</sub> analysis, five years (2007-2011) of meteorological data were processed for application in the AERMOD model. These data were purchased from a private vendor and represent five consecutive years of the most recent representative meteorological data in the Denver air basin. Meteorological data for the winter

months for each year was used in this analysis. These data arrived already formatted for use in AERMOD, so there was no need to use AERMET—AERMOD’s meteorological pre-processor.

In addition to surface characteristics, night-time dispersion in urban areas can be greater than in surrounding rural areas with similar surface characteristics as a result of the “urban heat island effect.” Because this PM<sub>10</sub> hotspot analysis falls within an urban area, the sources were treated as urban in AERMOD.

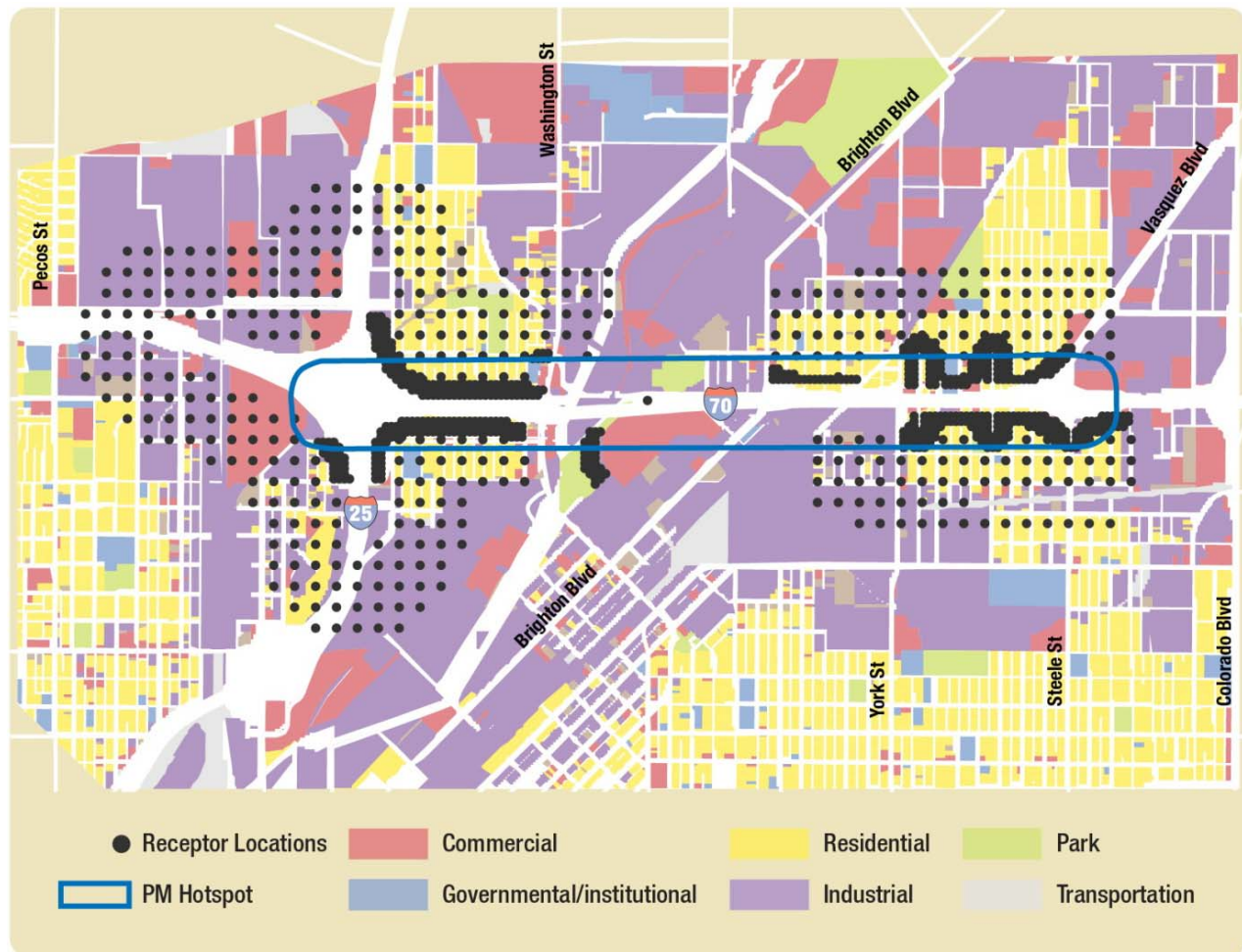
### **Receptor placement**

Receptors are locations in the project area where the air quality model estimates future PM<sub>10</sub> concentrations. Section 93.123(c)(1) of the Conformity Rule requires PM<sub>10</sub> hotspot analyses to estimate air quality concentrations at “appropriate receptor locations in the area substantially affected by the project,” i.e., a location that is suitable for comparison to the relevant PM<sub>10</sub> NAAQS.

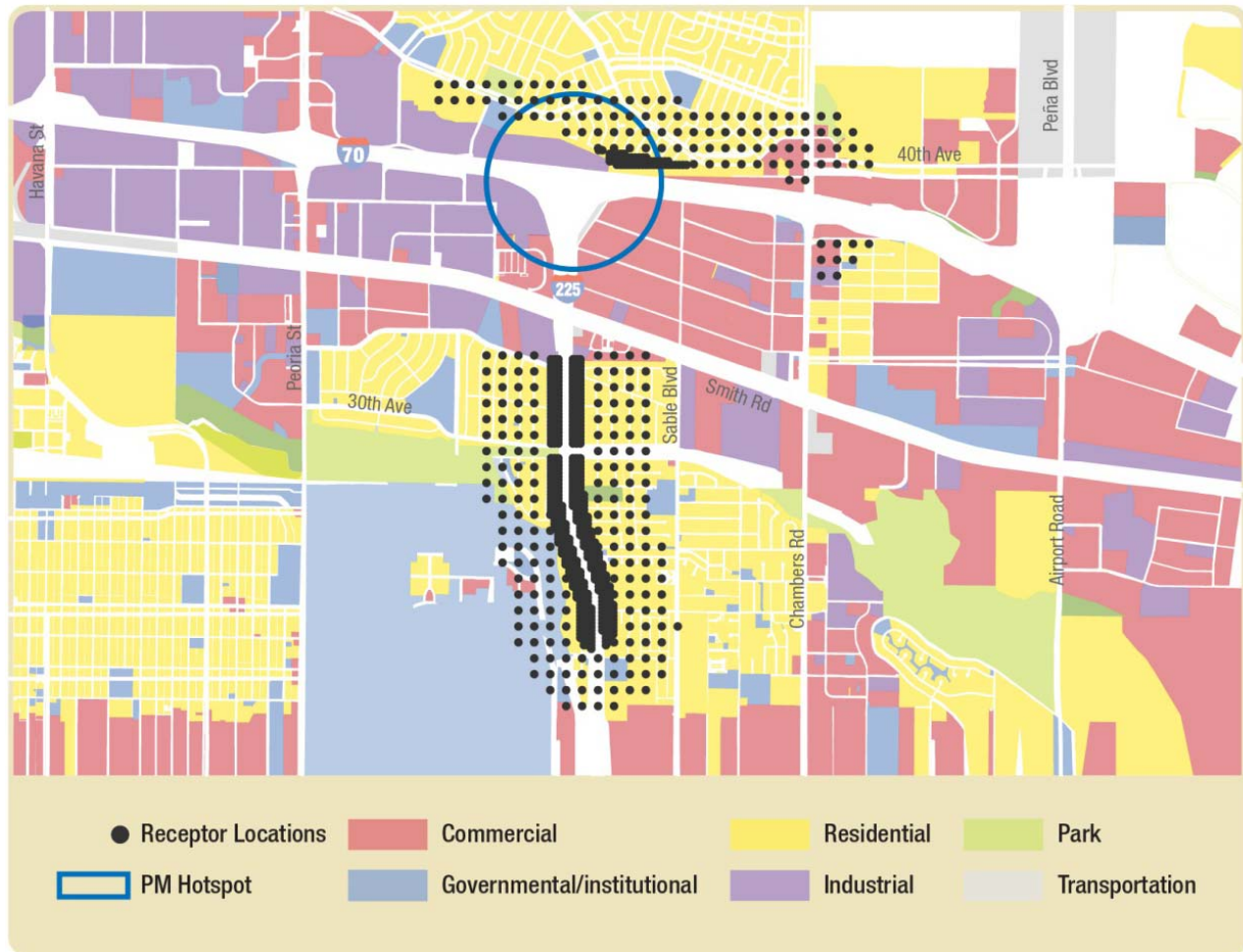
The appropriate design of the receptor network for this PM<sub>10</sub> hotspot analysis was determined through the Interagency Consultation process. To be of sufficient resolution to capture the concentration gradients throughout the hotspot study area, a nested grid was designed. Receptors were placed at 25 meter intervals in the area between the roadway edge and 100 meters away. Between 100 and 500 meters from the road’s edge, a spacing of 100 meters was used. The Flagpole option in AERMOD was used to define a receptor height of 1.5 meters. This receptor placement extends out to a sufficient distance from sources to account for emissions that affect concentrations throughout the project area. Furthermore, the dense placement of receptors assures that concentrations near locations of interest, such as Swansea Elementary School, are evaluated.

Typical receptor locations for the PM<sub>10</sub> hotspot analyses are shown in Figure 10 and Figure 11 for the two hotspot locations (each specific alternative modeled has a slightly different receptor network based on differences in the right-of-way for that alternative).

Figure 10. Typical Receptor Locations for the PM<sub>10</sub> Hotspot Analysis (I-70 at I-25)



**Figure 11. Typical Receptor Locations for the PM<sub>10</sub> Hotspot Analysis (I-70 at I-225)**



#### 4.4.6. Background concentrations

This hotspot analysis uses background PM<sub>10</sub> concentrations from ambient monitoring data. Identifying an appropriate monitor to use for PM<sub>10</sub> background concentrations was a key topic for air quality Interagency Consultation. A complicating factor is that there is no monitor that is upwind from the project area under most meteorological conditions that also captures the industrial contributions that the residents in the project area neighborhoods are concerned about.

Denver's Continuous Ambient Monitoring Program (CAMP) station and the Commerce City, Welby, and National Jewish Health Center sites are the closest monitors to the project area. The CAMP station is in the central business district and is not representative of land use anywhere else in the project corridor. The National Jewish Health site monitor does not record PM<sub>10</sub> emissions. Each of the monitors are downwind of at least one major highway, which means they may not represent a true background value.

After reviewing the locations of these three monitors on aerial photographs, the Commerce City site was selected as the background monitor since it best captures the industrial PM<sub>10</sub> contributions in the project area and is a reasonable distance from the I-70 corridor (it may best reflect actual background concentrations excluding I-70 impacts). The selection of the Commerce City site was made by CDOT through the Interagency Consultation process that included FHWA, EPA, and APCD.

The EPA's guidance requires use of the highest PM<sub>10</sub> value over a three-year period, excluding exceptional events, to represent background concentrations. For the Supplemental Draft EIS, the background concentrations were estimated using 2010 to 2012 data, resulting in a background PM<sub>10</sub> value of 113 µg/m<sup>3</sup>.

## 4.5. Methodology for criteria pollutants, mobile source air toxics, and greenhouse gases

Emissions inventories of NAAQS criteria pollutants, MSATs, and GHGs were developed for the No-Action Alternative and the Build Alternatives. The inventories allow for the assessment of these pollutants and their potential impacts by alternative. The methodologies to prepare the inventories and assess impacts are common to each of these three categories of pollutants. The inventories were prepared for 2010 and 2035 by the CDPHE/APCD using EPA's MOVES2010b (MOVES) model and interpolated for each interim five-year increment.

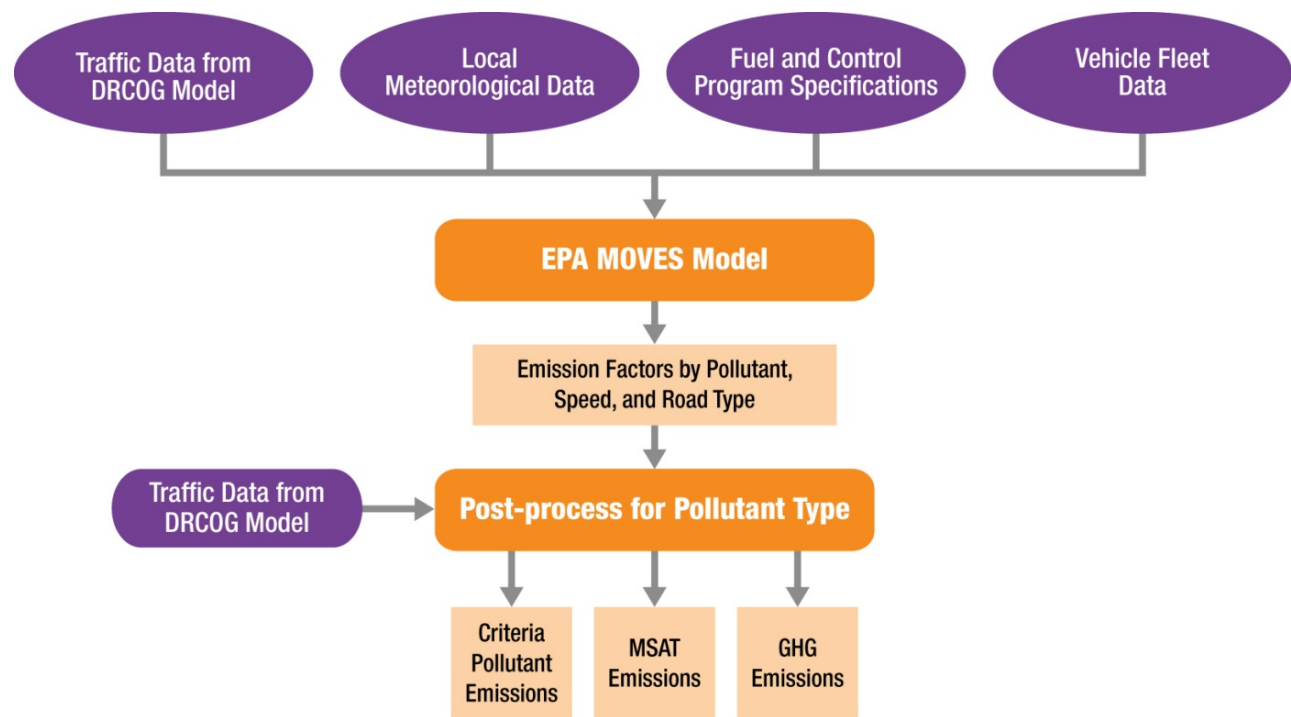
### 4.5.1. Approach, models, and data

EPA's and FHWA's guidance and reference documents cited previously were used to establish the overall approach, modeling input data, and other assumptions for preparing the emission inventories. The resulting inventories represent weekdays (24-hour period) for January and July in the respective analysis years.

#### Overview of the modeling process

Figure 12 shows the modeling process used for this analysis.

**Figure 12. Modeling process for the criteria pollutant, MSAT, and GHG analyses**



Traffic data—including traffic volumes, vehicle miles of travel, and travel speeds—from DRCOG's Compass model simulate the activities that generate emissions from motor vehicles. For this Supplemental Draft EIS, the following project alternatives were modeled with Compass:

- 2035 No-Action Alternative
- 2035 Revised Viaduct Alternative, General-Purpose (GP) Lanes Option

- 2035 Revised Viaduct Alternative, Managed Lanes (ML) Option
- 2035 Partial Cover Lowered (PCL) Alternative, Basic Option with GP Lanes
- 2035 PCL Alternative, Basic Option with Managed Lanes (ML)
- 2035 PCL Alternative, Modified Option with ML

The General-Purpose Lanes Option was not modeled for the Partial Cover Lowered Alternative, Modified Option. The No-Action Alternative and Revised Viaduct Alternative both have options that shift I-70 south or north. These shifts have no impact on traffic circulation and are each considered a single alternative for the purpose of projecting traffic, congested speeds, and emissions for all of the alternatives.

These alternatives have been modeled with sufficient detail for projecting traffic, congested speeds, and emissions for all of the alternatives. Local meteorological conditions, fuel specifications, and emissions control programs are input into the MOVES model, in addition to the travel model results. The MOVES model uses this information to estimate on-road mobile source (i.e., vehicle) emissions factors in units of grams per mile. The emissions factors are multiplied by the daily (24-hour weekday period) vehicle miles of travel for every roadway link in the study area based on the link's roadway functional classification and estimated congested speed. The emission inventories are the sum of the link emissions. The resulting inventories represent weekdays (24-hour period) for January and July in the respective analysis years.

### **Air quality model selection**

The latest version of EPA's MOVES model, MOVES2010b, was selected through the Interagency Consultation process for use in preparing the criteria pollutant, MSAT, and GHG emissions inventories. MOVES allows for the use of project-specific, local data where it is available, and it has the capability of modeling pollutant-origination processes that estimate exhaust and evaporative emissions, as well as brake and tire wear emissions, from all types of on-road vehicles.

### **Pollutants to analyze**

Analysis of NAAQS includes five criteria pollutants: CO, NO<sub>2</sub>, particulate matter (PM<sub>2.5</sub>, and PM<sub>10</sub>), SO<sub>2</sub>, and Ozone. The pollutant ozone is a regional issue that involves the interaction of various chemicals in the presence of sunlight, so it is addressed at the project level through its precursors—volatile organic compounds (VOC) and oxides of nitrogen (NO<sub>x</sub>). Because lead has been eliminated from on-road vehicle fuels, it is no longer a pollutant of concern from roadway emissions, so it is not included in the analysis of criteria pollutants. MSAT analyses cover the most recent list of seven priority MSATs in FHWA's 2012 guidance. The MOVES emissions factors for GHGs include adjustments for the most recent changes to the CAFE fuel economy standards. Identical travel and meteorological data were used for all pollutants. SO<sub>2</sub> was analyzed because it is a pollutant of general air quality concern and contributes to the overall air shed of the project study area. SO<sub>2</sub> is not considered a transportation-related criteria pollutant.

### **Geographic area**

The emissions inventories are based on a large geographic project area that encompasses the corridor study area and surrounding neighborhoods. The study area was determined based on the area in which forecasted traffic volumes change significantly between the No-Action and the Build Alternatives.

### **Analysis years**

As defined in the Air Quality Protocol developed through the Interagency Consultation process, the emission inventories were prepared for the 2010 base year and the regional transportation plan's horizon year of 2035 by CDPHE/APCD. To support the trends analysis, inventories were estimated for each intervening five-year increment: 2015, 2020, 2025, and 2030.

The project is anticipated for completion between 2020 and 2025, so 2025 is the first analysis year to contain a Build Alternative condition. Therefore, the 2010, 2015, and 2020 inventories are common to all alternatives for a given pollutant, whereas the 2025, 2030, and 2035 inventories are alternative-specific.

### Temporal and seasonal conditions

The emission inventories for criteria pollutants, MSATs, and GHGs represent a January weekday (24-hour period) and a July weekday (24-hour period) in the respective analysis years. The use of weekdays is consistent with peak traffic conditions that occur in the morning and evening rush hours on weekdays. Both January and July are reported separately to indicate peaking characteristics of the various pollutants.

### Planning assumptions

In preparing the emission inventories, the most recent planning assumptions consistent with the most recent conformity determination for the regional transportation plan and transportation improvement program were used by CDPHE/APCD. Many of these planning assumptions, such as existing and future households and employment, are built into the assumptions of the DRCOG Compass model.

### Traffic data

The traffic data (e.g., vehicle miles of travel, congested speeds) for this analysis was obtained from the 2010 base year Compass model and the 2035 DRCOG Compass model runs for the No-Action Alternative and Build Alternatives. The 2035 No-Action Alternative model is consistent with the model, network, and other assumptions used for the conformity determination of the regional transportation plan and transportation improvement program. The 2035 Build Alternatives were developed using the 2035 No-Action roadway network as a starting point.

The roadway networks in Compass include arterials, expressways, frontage roads, ramps, and freeways. Much of the collector street network in the region is also included. High-occupancy vehicle and high-occupancy tolled lanes are likewise included. Essentially, the only roads not included are local and residential streets and some collectors.

Each link in the model's roadway network includes basic roadway information, such as distance, number of lanes, roadway type (e.g., collector street, freeway), area type (e.g., central business district, urban, suburban, rural), tolls, and others. For the 2035 alternative model runs, the model provides forecasts of traffic volumes, congested speeds, and other information useful for long-range transportation planning and NEPA studies such as this. Congested speeds are average speeds estimated by the model based on the amount of traffic and congestion on the link. All of these data are available for each link in the network. These data were used to construct MOVES input files for average speed distribution and road type distribution.

The daily vehicle miles of travel for each alternative are shown in Table 8.

**Table 8. Vehicle miles of travel (daily, study area)**

Vehicle Type	2010 Base	2035 No-Action	2035 Revised Viaduct GP	2035 PCL GP	2035 PCL ML
Motorcycle	19,200	29,400	30,200	30,200	28,000
Passenger Car	3,517,600	5,320,600	5,554,400	5,550,700	5,409,200
Light Passenger Truck	2,460,800	3,725,500	3,888,800	3,886,200	3,781,400
Light Commercial Truck	822,100	1,244,600	1,299,200	1,298,300	1,263,300
Bus (intercity, transit, school)	11,700	19,300	19,500	19,600	17,900
Single-Unit Truck, Motor home	68,500	109,100	113,400	112,800	101,000
Combo Heavy Trucks	360,700	551,000	571,800	569,000	533,700
<b>Total*</b>	<b>7,260,600</b>	<b>10,999,400</b>	<b>11,477,200</b>	<b>11,466,900</b>	<b>11,134,500</b>

\*Totals may vary due to rounding.

### Travel distribution by vehicle type

The percentage of vehicle miles of travel attributed to each vehicle type is also called VMT mix and is an important component of an air quality analysis for freeway alternatives. In reality, VMT mix is different for every segment of road in the study area; but, for analysis purposes, the VMT mix is assumed to be the same for all links in a given roadway functional classification for a given alternative. In preparing the emission inventories, alternative-specific VMT mixes were used in the MOVES model. The base VMT mix was developed by CDPHE/APCD using CDOT's automated traffic recorder (ATR) data from the existing I-70 East corridor. The base VMT mix was used for the 2035 No-Action alternative. The No-Action VMT mix was adjusted for each Build Alternative to account for changes in heavy trucks reflected in the DRCOG Compass model runs. Table 9 shows the VMT mixes by alternative.

**Table 9. Freeway travel distribution by vehicle type (VMT mix)**

Vehicle Type	2035 No-Action	2035 Revised Viaduct GP	2035 PCL GP	2035 PCL GP + ML
Motorcycle	0.27%	0.26%	0.26%	0.25%
Passenger Car	48.37%	48.39%	48.41%	48.58%
Light Duty Personal Use Pickup	33.87%	33.88%	33.89%	33.96%
Light Duty Commercial Pickup	11.32%	11.32%	11.32%	11.35%
Bus	0.18%	0.17%	0.17%	0.16%
Single Unit Truck	0.99%	0.99%	0.98%	0.91%
Combo. Truck	5.01%	4.98%	4.96%	4.79%
<b>Total</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>

*\*Totals may vary due to rounding.*

The freeway VMT mix for the 2035 PCL GP + ML alternative is a weighted average of the managed lanes, which don't include heavy trucks, and the general purpose lanes, which do. No VMT mix was prepared for the 2035 Revised Viaduct GP + ML alternative because the alternative was not modeled in Compass. The emission inventories for this alternative were estimated based on the results for the other alternatives.

### Vehicle type and age distributions

The vehicle type and age distributions were obtained from the Colorado Department of Revenue and are consistent with those used in the most recent conformity determination for the Denver region. These distributions are used in the MOVES model and show the percent of vehicles by age (e.g., less than one year, one to two years, two to three years, etc.) for the following vehicle types:

- Motorcycle
- Passenger car
- Passenger truck
- Light commercial truck
- Intercity bus
- Transit bus
- School bus
- Refuse truck
- Single-unit short-haul truck
- Single-unit long-haul truck
- Motor home
- Combination short-haul truck
- Combination long-haul truck

The distributions are contained in Appendix B. The vehicle population data provided by CDPHE/APCD for 2010 is also included in the appendix.

### Temperature and humidity

Temperature and humidity data used as input to the MOVES model were obtained from the Denver International Airport weather station and are shown in Table 10 by month and hour.

**Table 10. Temperature and humidity data**

Hour	Temperature (F)		Humidity (%)	
	January	July	January	July
1	17.9	55.3	59.8	57.6
2	17.2	51.9	60.0	59.9
3	16.5	49.2	59.6	61.7
4	15.8	47.2	59.8	64.1
5	15.2	45.8	59.9	65.9
6	14.8	44.1	59.6	67.1
7	14.5	42.6	59.6	63.0
8	14.3	43.8	59.5	55.3
9	15.8	51.1	58.1	48.2
10	22.9	62.9	52.2	42.2
11	30.1	74.8	45.9	36.5
12	36.0	85.1	41.4	32.1
13	40.1	94.1	38.2	28.9
14	42.3	99.0	37.0	27.2
15	43.2	100.7	36.5	26.5
16	42.5	101.2	37.5	26.7
17	40.3	100.0	39.8	28.0
18	34.3	96.6	45.4	29.8
19	28.6	90.7	51.0	33.2
20	25.7	83.1	54.3	37.8
21	23.4	75.6	56.4	43.8
22	21.9	69.0	57.7	48.1
23	20.3	64.3	59.1	51.8
24	19.1	59.7	59.7	54.8

### Fuel specifications

The MOVES model requires parameters that represent the fuel specifications for a given area. The fuel specifications for this analysis were provided by CDPHE/APCD and are consistent with the most recent conformity determination for the region's transportation plan and improvement program. They are contained in Appendix B.

For the GHG inventory, a set of alternative vehicle fuel technology parameters were provided by FHWA to represent the most recent CAFÉ standards in place at the federal level. These alternative parameters, or correction factors, are only used for the GHG analysis and are contained in Appendix B.

### **Inspection and maintenance program**

The Denver region's existing and anticipated future vehicle inspection and maintenance (IM) program parameters were provided by CDPHE/APCD for the MOVES model. The data are contained in Appendix B.

#### **4.5.2. MOVES modeling**

As previously discussed, emissions factors were generated using MOVES at the county scale. In MOVES, the County Scale is one of three options for running the model. It facilitates the use of local input data to develop emissions factors. It does not mean that county-level emissions totals are generated. Rather, the emissions factors from MOVES are multiplied by the VMT at the roadway link level based on the speed estimated for the link. This is done for all links in the air quality study area so that the resulting emissions inventories represent the on-road mobile source emissions generated in the study area.

## **5. Existing Conditions**

### **5.1. Existing conditions—criteria pollutants**

This section addresses the existing conditions for the NAAQS criteria pollutants.

#### **5.1.1. Monitoring data/EPA air quality status**

Five air quality monitoring stations are located within or close to the study area, as shown in Figure 2. Denver's CAMP station and the Commerce City, Welby, and National Jewish Health (NJH) sites are the closest monitors to the project area. CAMP is in the Central Business District and is not representative of land use anywhere else in the project corridor. The NJH monitor does not record emissions of interest to this analysis. Table 11 contains the air monitoring data for the monitoring sites with data relevant to this project. Exceedances of NAAQS emissions standards are highlighted in the table. It should be noted that a single exceedance does not necessarily trigger a nonattainment designation. Chapter 2 of this report identifies the specific exceedance criteria. Even though several of the NAAQSs have become stricter in recent years, historical pollutant concentrations from monitoring sites within and near the study area suggest that air quality has improved over time despite increasing road congestion, continued industrial activities, and the influence of weather patterns.

As of December 2012, all areas in Colorado were in attainment of all NAAQS criteria pollutants except for ground-level ozone. Seven counties in the Denver metropolitan area and portions of two counties in the Colorado North Front Range are currently designated as nonattainment for exceeding the 1997 and 2008 8-hour ozone standard. The region was originally designated under the 1-hour standard, which has since been replaced with an 8-hour standard in 1997 and updated in 2008.

The Denver region was previously designated nonattainment for CO and PM<sub>10</sub>. The region was redesignated to attainment / maintenance status for CO by the EPA on December 14, 2001 (EPA, 2001), and for PM<sub>10</sub> by the EPA on September 16, 2002 (EPA, 2002a). Denver is in attainment for both the 1997 and 2006 PM<sub>2.5</sub> standards. As shown in Table 11, there have not been any exceedances of the CO standard at any of the four monitoring stations in the study area since 1999. There has been one exceedance of the 1997 24-hour PM<sub>2.5</sub> standard in 2001 at the CAMP station, but this was not enough to trigger a nonattainment designation for that pollutant.

**Table 11. Pollutant monitoring data**

Pollutant	Averaging Time	Existing NAAQS Standard	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Auraria (AURA)—1300 Blake Street, 080310019 (Decommissioned in 2011)																
CO (ppm)	8-Hour (2 <sup>nd</sup> Max)	9 ppm	5.2	4.6	4	3.6	3.4	3.6	2.3	2.6	2.4	3	1.8	2.2	1.7	
		(10 mg/m <sup>3</sup> )														
	1-Hour (2 <sup>nd</sup> Max)	35 ppm	11.2	8.6	7	7.5	6.1	5.8	4.2	4.2	4.1	4.5	3.6	3.3	2.7	
		(40 mg/m <sup>3</sup> )														
Denver CAMP (Continuous Air Monitoring Program)—2105 Broadway Avenue, 080310002																
CO (ppm)	8-Hour (2 <sup>nd</sup> Max)	9 ppm	5	5.4	4.1	3.7	4.5	4.1	2.5	3.1	2.8	3.1	2.2	2.4	1.8	2
		(10 mg/m <sup>3</sup> )														
	1-Hour (2 <sup>nd</sup> Max)	35 ppm	12.1	12.8	9.3	7.4	14.9	8.7	4.3	4.6	5.9	7	6.8	4	3.1	4
		(40 mg/m <sup>3</sup> )														
Ozone (ppm)	8-Hour (max)	0.075 ppm	No Data	No Data	No Data	No Data	No Data	No Data	0.06	0.071	0.064	0.062	No Data	No Data	No Data	No Data
PM <sub>10</sub> (µg/m <sup>3</sup> )	Annual Mean	Revoked	29.9	33.8	38.4	37.5	33.7	29.1	28.3	27.3	27.4	28.6	25.7	26.6	32.9	31.6
	24-Hour (2 <sup>nd</sup> Max)	150 µg/m <sup>3</sup>	49	57	75	75	61	53	57	51	55	56	42	52	80	103
PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Annual Mean	12 µg/m <sup>3</sup>	8.44	10.78	11.81	10.1	10.5	9.36	9.34	8.46	9.84	8.04	7.52	7.81	7.51	7.95
	24-Hour (2 <sup>nd</sup> Max)	65 µg/m <sup>3</sup>	29.2	36.6	68	41.1	33.4	40.2	36.2	31.4	53.6					
	24-Hour (2 <sup>nd</sup> Max)	35 µg/m <sup>3</sup>										30.3	25.7	25.3	28	32.2

**Table 11. Pollutant monitoring data**

Pollutant	Averaging Time	Existing NAAQS Standard	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
NO <sub>2</sub> (ppm)	Annual Mean	0.053 ppm (100 µg/m <sup>3</sup> )	0.033	0.037	0.037	0.035	0.035	0.027	0.028	0.029	0.027	0.02	0.031	0.027	0.024	0.025
	1-hour	0.100 ppm												0.08	0.093	0.076
SO <sub>2</sub> (ppm)	24-Hour (2 <sup>nd</sup> Max)	.14 ppm	0.013	0.017	0.026	0.023	0.013	0.011	0.009	0.009	0.011	0.01	0.005			
	1-Hour (2 <sup>nd</sup> Max)	0.075 ppm												0.045	0.042	0.043
<b>Commerce City/Alsop Elementary (COMM)—080010006</b>																
PM <sub>10</sub> (µg/m <sup>3</sup> )	Annual Mean	Revoked	36.6	42.7	35.7	37.6	38.2	34.6	38.9	35	33.8	31.5	27.6	28.2	24.6	29.5
	24-Hour (2 <sup>nd</sup> Max)	150 µg/m <sup>3</sup>	141	134	112	98	115	103	98	111	111	107	93	68	65	86
PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Annual Mean	12 µg/m <sup>3</sup>	9.31	11.61	10.5	10.11	10.64	9.92	9.79	7.89	10.72	9.46	8.12	8.62	7.5	8.6
	24-Hour (2 <sup>nd</sup> Max)	65 µg/m <sup>3</sup>	12.1	25.2	32.3	25.7	27.9	23.2	24	27.5	48.7					
	24-Hour (2 <sup>nd</sup> Max)	35 µg/m <sup>3</sup>										26.7	23.6	24.3	20	28.7
<b>Welby (WBX)—3174 E. 78th Avenue, 080013001</b>																
CO (ppm)	8-Hour (2 <sup>nd</sup> Max)	9 ppm	3.6	2.9	3.3	2.6	3	2.8	2.2	2.5	2.1	2.4	1.9	1.8	1.6	1.3
		(10 mg/m <sup>3</sup> )														
	1-Hour (2 <sup>nd</sup> Max)	35 ppm	6	4.3	5.8	4.4	5.2	4	3.3	3.8	3	3.9	2.6	2.3	2.4	2.2
		(40 mg/m <sup>3</sup> )														

**Table 11. Pollutant monitoring data**

Pollutant	Averaging Time	Existing NAAQS Standard	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Ozone (ppm)	8-Hour (max)	0.08 ppm	0.081	0.066	0.066	0.074	0.07	0.07	0.076	0.081	0.086					
	8-Hour (max)	0.075 ppm										0.085	0.078	0.068	0.089	0.089
PM <sub>10</sub> (µg/m <sup>3</sup> )	Annual Mean	Revoked	22.1	24	27.9	24.6	23.6	29.5	32.3	27.8	29.9	25.5	23.7	26.3	28.4	22.8
	24-Hour (2 <sup>nd</sup> Max)	150 µg/m <sup>3</sup>	42	43	55	45	41	95	66	49	73	61	45	52	61	85
NO <sub>2</sub> (ppm)	Annual Mean	0.053 ppm (100 µg/m <sup>3</sup> )	0.02	0.015	0.025	0.02	0.022	0.022	0.02	0.019	0.021	0.017	0.014	0.016	0.018	0.019
	1-hour	0.100 ppm												0.063	0.075	0.075
SO <sub>2</sub> (ppm)	24-Hour (2 <sup>nd</sup> Max)	Revoked 06/2010)	0.011	0.009	0.012	0.01	0.009	0.009	0.008	0.006	0.005	0.006	0.005			
	1-Hour (2 <sup>nd</sup> Max)	0.075 ppm												0.038	0.037	0.046

Note: Exceedances of the criteria pollutant standards are highlighted.

### 5.1.2. Transportation conformity

As discussed previously, regional and project-level conformity applies to transportation projects in air quality nonattainment and attainment/maintenance areas (Transportation Conformity Rule, 40 CFR 93). Project-level conformity is conducted for projects that are funded and/or approved by FHWA or FTA and/or considered regionally significant (40 CFR 93.102). To pass regional conformity, the project must be included in a conforming RTP and TIP (40 CFR 93.115). Project level conformity also includes a hot-spot analysis in CO areas and for projects of air quality concern in PM areas. A project cannot create new, increase the frequency of, or exacerbate the severity of air quality violations (40 CFR 93.116). Furthermore, the design and concept for the proposed project must be adequately defined and must remain consistent with the project's definition in the conforming RTP and TIP (40 CFR 93.115).

If the project changes in concept or design during the planning process, or if it was not originally included in the RTP and TIP, the regional conformity analysis would need to be revisited before the project can proceed (40 CFR 93.107). This is the case with I-70 East. There are some elements of the alternatives included in the *2035 Metro Vision Regional Transportation Plan* (DRCOG, 2011), but, neither the No-Action Alternative nor the Current Alignment Alternative are fully included in the RTP. An amendment to the RTP will be necessary once a preferred alternative is selected and before FHWA issues the Record of Decision.

### 5.1.3. Existing (2010) criteria pollutant emissions

Emission inventories were developed in accordance with the procedures and assumptions presented in Chapter 4, *Methodology*, for the six NAAQS criteria pollutants. Emission inventories were calculated as estimates of the total daily pollutant emissions expected to be generated as a result of the implementation of each Build Alternative. The year 2010 is used to represent existing levels of emissions, as this year is consistent with the base year of the DRCOG regional travel demand model and the conformity determination for the regional transportation plan and improvement program. Existing emissions of criteria pollutants in the I-70 air quality study area are shown in Table 12.

**Table 12. Existing (2010) criteria pollutant emissions (tons per day)**

Pollutant	January	July
CO	54.22	56.53
NO <sub>x</sub>	15.95	15.25
SO <sub>2</sub>	0.09	0.07
VOC	3.46	3.51
PM <sub>10</sub>	0.95	0.70
PM <sub>2.5</sub>	0.77	0.54

*Note: CO and VOC emissions are higher in the summer because there are more cold starts in summer, and thus more cars traveling the (project area) highways while their catalytic converters are still warming up.*

## 5.2. Existing conditions—mobile source air toxics

Controlling air toxic emissions became a national priority when Congress passed the Clean Air Act Amendments of 1990. The amendments mandated that the EPA regulate HAPs. EPA assessed HAPs in their latest rule on the *Control of Hazardous Air Pollutants from Mobile Sources* (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007). In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers. These are acrolein, benzene, 1,3 butadiene, diesel particulate matter plus diesel exhaust organic gases, formaldehyde, naphthalene, and polycyclic organic matter.

FHWA recently released its revised interim guidance on when and how to analyze MSATs in the NEPA process for highways (Marchese, December 6, 2012). The guidance describes a tiered approach for MSAT analysis in NEPA projects: (1) no analysis necessary for projects with no potential MSAT effects; (2) a *qualitative* analysis for projects with low potential MSAT effects; and (3) a *quantitative* analysis to differentiate alternatives with higher potential MSAT effects. One of the criteria requiring a quantitative analysis is a project with design year traffic volumes in the range of 140,000 to 150,000 vehicles per day or

greater, which the I-70 East project exceeds by a wide margin in the 2035 design year. The quantitative approach is presented in Chapter 4, *Methodology*. It includes an emissions burden analysis that forecasts emissions trends over time to use as the basis for comparing the effects of the alternatives.

### **5.2.1. Incomplete or unavailable MSAT information**

Although FHWA guidance recommends a quantitative analysis of MSATs, there are no national standards in place to regulate them. Knowledge of MSAT is progressing and research continues. FHWA has issued standard language that addresses incomplete or unavailable information related to MSATs. That language is repeated here for reference:

#### **Incomplete or Unavailable Information for Project-Specific MSAT Health Impacts Analysis**

*In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.*

*The U.S. Environmental Protection Agency (EPA) is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the Clean Air Act and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the Integrated Risk Information System (IRIS), which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA, <http://www.epa.gov/iris/>). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude.*

*Other organizations are also active in the research and analyses of the human health effects of MSAT, including the Health Effects Institute (HEI). Two HEI studies are summarized in Appendix D of FHWA's Interim Guidance Update on Mobile source Air Toxic Analysis in NEPA Documents. Among the adverse health effects linked to MSAT compounds at high exposures are; cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI, <http://pubs.healtheffects.org/view.php?id=282>) or in the future as vehicle emissions substantially decrease (HEI, <http://pubs.healtheffects.org/view.php?id=306>).*

*The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts - each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable.*

*It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roadways; to determine the portion of time that people are actually exposed at a specific location; and to establish the extent attributable to a proposed action, especially given that some of the information needed is unavailable.*

*There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (<http://pubs.healtheffects.org/view.php?id=282> ). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The EPA (<http://www.epa.gov/risk/basicinformation.htm#g> ) and the HEI (<http://pubs.healtheffects.org/getfile.php?u=395>) have not established a basis for quantitative risk assessment of diesel PM in ambient settings.*

*There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the Clean Air Act to determine whether more stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine an "acceptable" level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA's approach to addressing risk in its two step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than deemed acceptable.*

*Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response, that are better suited for quantitative analysis.*

### **5.2.2. Existing (2010) MSAT emissions**

Emission inventories were modeled in accordance with the procedures and assumptions presented in Chapter 4, *Methodology*. The year 2010 is used to represent existing levels of emissions as this year is consistent with the base year of the DRCOG regional travel demand model and the conformity determination for the regional transportation plan and improvement program. Existing MSAT emissions in the I-70 air quality study area are shown in Table 13.

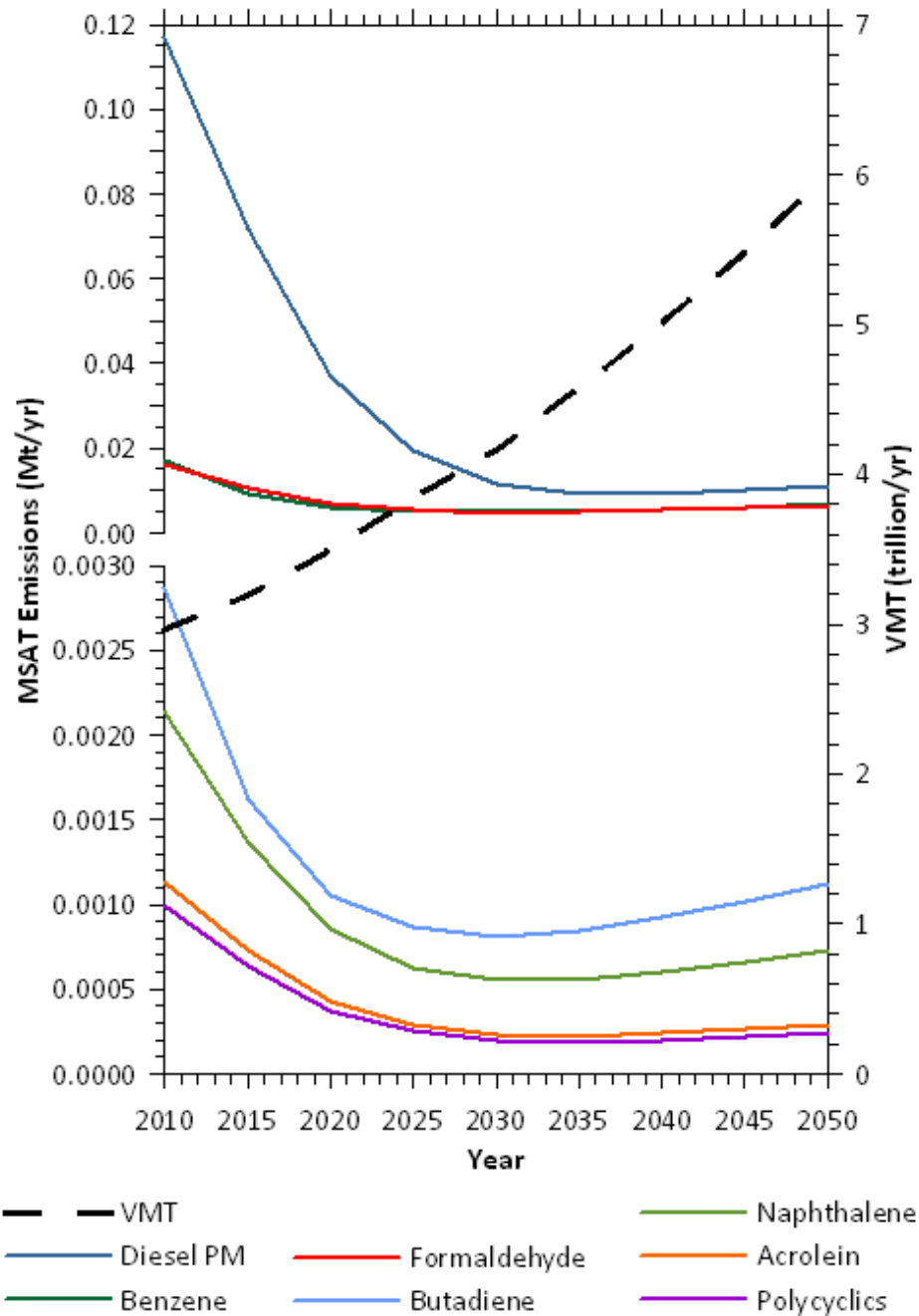
**Table 13. Existing (2010) MSAT emissions (tons per day)**

Pollutant	January	July
Benzene	0.069	0.096
Formaldehyde	0.052	0.056
1,3 Butadiene	0.010	0.012
Acrolein	0.004	0.004
Naphthalene	0.007	0.008
Polycyclic organic matter	0.003	0.003
Diesel particulate matter	0.395	0.398

### 5.2.3. National MSAT trends

According to an FHWA analysis using EPA's MOVES2010b model, as shown in Figure 13, even if vehicle-miles travelled (VMT) increase by 102 percent as assumed from 2010 to 2050, a combined reduction of 83 percent in the total annual emissions for the priority MSAT is projected for the same time period (Marchese, 2012).

**Figure 13. U.S. annual vehicle miles travelled vs. mobile source air toxics emissions, 2010 to 2050 using EPA's MOVES2010b model**



Source: [http://www.fhwa.dot.gov/environment/air\\_quality/air\\_toxics/policy\\_and\\_guidance/aqintguidmem.cfm](http://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/aqintguidmem.cfm) (Marchese, 2012)

Note: Trends for specific locations may be different, depending on locally derived information representing vehicle-miles travelled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors.

#### **5.2.4. MSAT research**

The following discussion is taken directly from the FHWA MSAT guidance (Marchese, 2012) and repeated here for reference as required by the guidance.

*Human epidemiology and animal toxicology experiments indicate that many chemicals or mixtures termed air toxics have the potential to impact human health. As toxicology, epidemiology and air contaminant measurement techniques have improved over the decades, scientists and regulators have increased their focus on the levels of each chemical or material in the air in an effort to link potential exposures with potential health effects. The EPA's list of 21 mobile source toxics represents their prioritization of these chemicals or materials for further study and evaluation. The EPA's strategy for evaluating air toxic compounds effects is focused on both national trends and local impacts. The FHWA has embarked on an air toxics research program with the intent of understanding the mobile source contribution and its impact on local and national air quality. Several of studies either initiated or supported by FHWA are described below<sup>1</sup>.*

*Air toxics emissions from mobile sources have the potential to impact human health and often represent a regulatory agency concern. The FHWA has responded to this concern by developing an integrated research program to answer the most important transportation community questions related to air toxics, human health, and the NEPA process. To this end, FHWA has performed, funded or is currently managing several research projects. Many of these projects are based on an Air Toxics Research Workplan that provides a roadmap for agency research efforts<sup>2</sup>. These efforts include:*

##### **The National Near Roadway MSAT Study**

*The FHWA, in conjunction with the EPA and a consortium of State departments of transportation, studied the concentration and physical behavior of MSAT and mobile source PM 2.5 in Las Vegas, Nevada and Detroit, Michigan. The study criteria dictated that the study site be open to traffic and have 150,000 Annual Average Daily Traffic or more. These studies were intended to provide knowledge about the dispersion of MSAT emissions with the ultimate goal of enabling more informed transportation and environmental decisions at the project-level. These studies are unique in that the monitored data was collected for the entire year. The Las Vegas, NV report revealed there are a large number of influences in this urban setting and researchers must look beyond the roadway to find all the sources in the near road environment. Additionally, in Las Vegas, meteorology played a large role in the concentrations measured in the near road study area. More information is available at [http://www.fhwa.dot.gov/environment/air\\_quality/air\\_toxics/research\\_and\\_analysis/mobile\\_source\\_air\\_toxics/](http://www.fhwa.dot.gov/environment/air_quality/air_toxics/research_and_analysis/mobile_source_air_toxics/).*

##### **Traffic-Related Air Pollution**

##### **Going One Step Beyond: A Neighborhood Scale Air Toxics Assessment in North Denver (The Good Neighbor Project)**

*In 2007, the Denver Department of Environmental Health (DDEH) issued a technical report entitled Going One Step Beyond: A Neighborhood Scale Air Toxics Assessment in North Denver (The Good Neighbor Project). This research project was funded by FHWA. In this study, DDEH conducted a neighborhood-scale air toxics assessment in North Denver, which includes a portion of the proposed I-70 East project area. Residents in this area have been very concerned about both existing health effects in their neighborhoods (from industrial activities, hazardous waste sites, and traffic) and potential health impacts from changes to I-70.*

The study was designed to compare modeled levels of the six priority MSATs identified in FHWA's 2006 guidance with measurements at existing MSAT monitoring sites in the study area. MOBILE6.2 emissions factors and the ISC3ST dispersion model were used (some limited testing of the CALPUFF model was also performed). Key findings include: 1) modeled mean annual concentrations from highways were well below estimated Integrated Risk Information System (IRIS) cancer and non-cancer risk values for all six MSAT; 2) modeled concentrations dropped off sharply within 50 meters of roadways; 3) modeled MSAT concentrations tended to be higher along highways near the Denver Central Business District (CBD) than along the I-70 East corridor (in some cases, they were higher within the CBD itself, as were the monitored values); and 4) dispersion model results were generally lower than monitored concentrations but within a factor of two at all locations.

### **Mobile Source Air Toxic Hotspot**

Given concerns about the possibility of MSAT exposure in the near road environment, The Health Effects Institute (HEI) dedicated a number of research efforts at trying to find a MSAT "hotspot." In 2011 three studies were published that tested this hypothesis. In general the authors confirm that while highways are a source of air toxics, they were unable to find that highways were the only source of these pollutants and determined that near road exposures were often no different or no higher than background or ambient levels of exposure, and hence no true hotspots were identified. These links provide additional information <http://pubs.healtheffects.org/getfile.php?u=659> page 137, <http://pubs.healtheffects.org/getfile.php?u=656> page 143, and <http://pubs.healtheffects.org/getfile.php?u=617> page 87, where monitored on-road emissions were higher than emission levels monitored near road residences, but the issue of hotspot was not ultimately discussed.

### **Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects**

In January 2010, HEI released Special Report #17, investigating the health effects of traffic related air pollution. The goal of the research was to synthesize available information on the effects of traffic on health. Researchers looked at linkages between: (1) traffic emissions (at the tailpipe) with ambient air pollution in general, (2) concentrations of ambient pollutants with human exposure to pollutants from traffic, (3) exposure to pollutants from traffic with human-health effects and toxicologic data, and (4) toxicologic data with epidemiological associations. Challenges in making exposure assessments, such as quality and quantity of emissions data and models, were investigated, as was the appropriateness of the use of proximity as an exposure-assessment model. Overall, researchers felt that there was "sufficient" evidence for causality for the exacerbation of asthma. Evidence was "suggestive but not sufficient" for other health outcomes such as cardiovascular mortality and others. Study authors also note that past epidemiologic studies may not provide an appropriate assessment of future health associations as vehicle emissions are decreasing overtime. The report is available from HEI's website at <http://www.healtheffects.org/>. The FHWA provides financial support to HEI's research work.

### **HEI Special Report #16**

In November 2007, the HEI published Special Report #16: Mobile-Source Air Toxics: A Critical Review of the Literature on Exposure and Health Effects. The purpose of this Report was to accomplish the following tasks:

- Use information from the peer-reviewed literature to summarize the health effects of exposure to the 21 MSATs defined by the EPA in 2001;
- Critically analyze the literature for a subset of priority MSAT; and

- *Identify and summarize key gaps in existing research and unresolved questions about the priority MSAT.*

*The HEI chose to review literature for acetaldehyde, acrolein, benzene, 1,3 butadiene, formaldehyde, naphthalene, and polycyclic organic matter (POM). Diesel exhaust was included, but not reviewed in this study since it had been reviewed by HEI and EPA recently. In general, the Report concluded that the cancer health effects due to mobile sources are difficult to discern since the majority of quantitative assessments are derived from occupational cohorts with high concentration exposures and some cancer potency estimates are derived from animal models. The Report suggested that substantial improvements in analytical sensitivity and specificity of biomarkers would provide better linkages between exposure and health effects. Noncancer endpoints were not a central focus of most research, and therefore require further investigation. Subpopulation susceptibility also requires additional evaluation. The study is available from HEI's website at <http://www.healtheffects.org/>.*

### **Kansas City PM Characterization Study (Kansas City Study)**

*This study was initiated by EPA to conduct exhaust emissions testing on 480 light-duty, gasoline vehicles in the Kansas City Metropolitan Area (KCMA). Major goals of the study included characterizing PM emissions distributions of a sample of gasoline vehicles in Kansas City; characterizing gaseous and PM toxics exhaust emissions; and characterizing the fraction of high emitters in the fleet. In the process, sampling methodologies were evaluated. Overall, results from the study were used to populate databases for the MOVES emissions model. The FHWA was one of the research sponsors. This study is available on EPA's website at: <http://www.epa.gov/otaq/emission-factors-research/420r08009.pdf>*

### **Estimating the Transportation Contribution to Particulate Matter Pollution (Air Toxics Supersite Study)**

*The purpose of this study was to improve understanding of the role of highway transportation sources in particulate matter (PM) pollution. In particular, it was important to examine uncertainties, such as the effects of the spatial and temporal distribution of travel patterns, consequences of vehicle fleet mix and fuel type, the contribution of vehicle speed and operating characteristics, and influences of geography and weather. The fundamental methodology of the study was to combine EPA research-grade air quality monitoring data in a representative sample of metropolitan areas with traffic data collected by State departments of transportation (DOTs) and local governments.*

*Phase I of the study, the planning and data evaluation stage, assessed the characteristics of EPA's ambient PM monitoring initiatives and recruited State DOTs and local government to participate in the research. After evaluating and selecting potential metropolitan areas based on the quality of PM and traffic monitoring data, nine cities were selected to participate in Phase II. The goal of Phase II was to determine whether correlations could be observed between traffic on highway facilities and ambient PM concentrations. The Phase I report was published in September 2002. Phase II included the collection of traffic and air quality data and data analysis. Ultimately, six cities participated: New York City (Queens), Baltimore, Pittsburgh, Atlanta, Detroit and Los Angeles.*

*In Phase II, air quality and traffic data were collected. The air quality data was obtained from EPA AIRS AQS system, Supersite personnel, and NARSTO data archive site. Traffic data included ITS (roadway surveillance), Coverage Counts (routine traffic monitoring) and Supplemental Counts (specifically for research project). Analyses resulted in the conclusion that only a weak correlation existed between PM<sub>2.5</sub> concentrations and traffic activity for several of the sites. The existence of general trends indicates a relationship, which however is primarily unquantifiable. Limitations of the study include the assumption that traffic sources are close enough to ambient monitors to provide sufficiently strong source strength, that vehicle activity is an appropriate surrogate for mobile*

*emissions, and lack of knowledge of other factors such as non-traffic sources of PM and its precursors. A paper documenting the work of Phase II was presented at the 2004 Emissions Inventory Conference and is available at <http://www.epa.gov/ttn/chief/conference/ei13/mobile/black.pdf>.*

### **5.3. Existing conditions—greenhouse gases**

Emission inventories for greenhouse gases were prepared as specified in Chapter 4, *Methodology*. The daily GHG emission inventories were estimated by CDPHE/APCD to be 4,064 and 4,318 tons per weekday in January and July 2010, respectively. There are no specific requirements for conducting a GHG analysis for a NEPA project. However, the Air Quality Protocol developed through the Interagency Consultation process calls for the reporting of global, national, statewide, and regional emissions of GHGs to provide context for the study area emissions calculated for the I-70 alternatives. Much of the following discussions comes from FHWA's standard GHG language for NEPA analyses, updated with project-specific information.

Climate change is an important national and global concern. While the earth has gone through many natural changes in climate in its history, there is general agreement that the earth's climate is currently changing at an accelerated rate and will continue to do so for the foreseeable future. Anthropogenic (human-caused) greenhouse gas emissions contribute to this rapid change. Carbon dioxide makes up the largest component of these GHG emissions. Other prominent transportation GHGs include methane and nitrous oxide.

Many GHGs occur naturally. Water vapor is the most abundant GHG and makes up approximately two thirds of the natural greenhouse effect. However, the burning of fossil fuels and other human activities are adding to the concentration of GHGs in the atmosphere. Many GHGs remain in the atmosphere for time periods ranging from decades to centuries. GHGs trap heat in the earth's atmosphere. Because atmospheric concentration of GHGs continues to climb, our planet will continue to experience climate-related phenomena. For example, warmer global temperatures can cause changes in precipitation and sea levels.

To date, no national standards have been established regarding GHGs, nor has EPA established criteria or thresholds for ambient GHG emissions pursuant to its authority to establish motor vehicle emission standards for CO<sub>2</sub> under the Clean Air Act. However, there is a considerable body of scientific literature addressing the sources of GHG emissions and their adverse effects on climate, including reports from the Intergovernmental Panel on Climate Change, the US National Academy of Sciences, and EPA and other Federal agencies.

GHGs are different from other air pollutants evaluated in Federal environmental reviews because their impacts are not localized or regional due to their rapid dispersion into the global atmosphere, which is characteristic of these gases. The *affected environment* for CO<sub>2</sub> and other GHG emissions is the entire planet. In addition, from a quantitative perspective, global climate change is the cumulative result of numerous and varied emissions sources (in terms of both absolute numbers and types), each of which makes a relatively small addition to global atmospheric GHG concentrations. In contrast to broad scale actions such as actions involving an entire industry sector or very large geographic areas, it is difficult to isolate and understand the GHG emissions impacts for a particular transportation project. Furthermore, presently there is no scientific methodology for attributing specific climatological changes to a particular transportation project's emissions.

Under NEPA, detailed environmental analysis should be focused on issues that are significant and meaningful to decision-making. FHWA has concluded, based on the nature of GHG emissions and the exceedingly small potential GHG impacts of the proposed action, as discussed below and shown in Table 14, that the GHG emissions from the proposed action will not result in "reasonably foreseeable significant adverse impacts on the human environment" (40 CFR 1502.22(b)). The GHG emissions from the project Build Alternatives will be insignificant, and will not play a meaningful role in a determination of the environmentally preferable alternative or the selection of the preferred alternative. More detailed information on GHG emissions "is not essential to a reasoned choice among reasonable alternatives" (40 CFR 1502.22(a)) or to making a decision in the best overall public interest based on a balanced consideration of

transportation, economic, social, and environmental needs and impacts (23 CFR 771.105(b)). For these reasons, a limited alternatives-level GHG analysis has been performed for this project based on emission inventories for each alternative for each 5 year increment between 2010 and 2035. This allows for a basic comparison of potential GHG emissions among alternatives.

The context in which the emissions from the proposed project will occur, together with the expected GHG emissions contribution from the project, illustrate why the project's GHG emissions will not be significant and will not be a substantial factor in the decision-making. The transportation sector is the second largest source of total GHG emissions in the U.S., behind electricity generation. The transportation sector was responsible for approximately 27 percent of all anthropogenic GHG emissions in the U.S. in 2010.<sup>1</sup> The majority of transportation GHG emissions are the result of fossil fuel combustion. CO<sub>2</sub> makes up the largest component of these GHG emissions. U.S. CO<sub>2</sub> emissions from the consumption of energy accounted for about 18 percent of worldwide energy consumption CO<sub>2</sub> emissions in 2010.<sup>2</sup> U.S. transportation CO<sub>2</sub> emissions accounted for about 6 percent of worldwide CO<sub>2</sub> emissions.<sup>3</sup>

While the contribution of GHGs from transportation in the U.S. as a whole is a large component of U.S. GHG emissions, as the scale of analysis is reduced the GHG contributions become quite small. Using CO<sub>2</sub> because of its predominant role in GHG emissions, Table 14, below, presents the relationship between current and projected Colorado highway CO<sub>2</sub> emissions and total global CO<sub>2</sub> emissions, as well as information on the scale of the project relative to statewide travel activity.

Based on emissions estimates from EPA's Motor Vehicle Emissions Simulator (MOVES) model<sup>4</sup>, and global CO<sub>2</sub> estimates and projections from the Energy Information Administration, CO<sub>2</sub> emissions from motor vehicles in the entire state of Colorado contributed less than one tenth of one percent of global emissions in 2010 (0.0813%). These emissions are projected to contribute an even smaller fraction (0.0612%) in 2040<sup>5</sup>. Vehicle miles traveled (VMT) in the project study area represents 4.7% of total Colorado travel activity; and the project itself would increase statewide VMT by an estimated 0.0%. (Note that the project study area, as defined for the MSAT analysis, includes travel on many other roadways in addition to the proposed project.) As a result, based on the Build Alternative with the highest VMT<sup>6</sup>, FHWA estimates that the proposed project could result in a potential increase in global CO<sub>2</sub> emissions in 2040 of 0.000047% (less than one ten-thousandth of one percent). This very small change in global emissions is well within the range of uncertainty associated with future emissions estimates.<sup>7, 8</sup>

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<sup>1</sup> Calculated from data in U.S. Environmental Protection Agency, Inventory of Greenhouse Gas Emissions and Sinks, 1990-2010.

<sup>2</sup> Calculated from data in U.S. Energy Information Administration International Energy Statistics, Total Carbon Dioxide Emissions from the Consumption of Energy, <http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=90&pid=44&aid=8>, accessed 2/25/13.

<sup>3</sup> Calculated from data in EIA figure 104: <http://www.eia.gov/forecasts/archive/ieo10/emissions.html> and EPA table ES-3: <http://epa.gov/climatechange/emissions/downloads11/US-GHG-Inventory-2011-Executive-Summary.pdf>

<sup>4</sup> <http://www.epa.gov/otaq/models/moves/index.htm>. EPA's MOVES model can be used to estimate vehicle exhaust emissions of carbon dioxide (CO<sub>2</sub>) and other GHGs. CO<sub>2</sub> is frequently used as an indicator of overall transportation GHG emissions because the quantity of these emissions is much larger than that of all other transportation GHGs combined, and because CO<sub>2</sub> accounts for 90-95% of the overall climate impact from transportation sources. MOVES includes estimates of both emissions rates and VMT, and these were used to estimate the Colorado statewide highway emissions in Table 5-3.

<sup>5</sup> Colorado emissions represent a smaller share of global emissions in 2040 because global emissions increase at a faster rate.

<sup>6</sup> Selected to represent a "worst case" for purposes of this comparison; the Preferred Alternative may have a smaller contribution.

<sup>7</sup> For example, Figure 114 of the Energy Information Administration's *International Energy Outlook 2010* shows that future emissions projections can vary by almost 20%, depending on which scenario for future economic growth proves to be most accurate.

<sup>8</sup> When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency is required make clear that such information is lacking (40 CFR 1502.22). The methodologies for forecasting GHG emissions from transportation projects continue to evolve and the data provided should be considered in light of the constraints affecting the currently available methodologies. As previously stated, tools such as EPA's MOVES model can be used to estimate

**Table 14. Statewide and Project Emissions Potential, Relative to Global Totals**

	Global CO <sub>2</sub> emissions, MMT <sup>9</sup>	Colorado motor vehicle CO <sub>2</sub> emissions, MMT <sup>10</sup>	Colorado motor vehicle emissions, % of global total	Project study area VMT, % of statewide VMT	Percent change in statewide VMT due to project
Current Conditions (2010)	29,670	24.1	0.0813%	4.7%	(None)
Future Projection (2040)	45,500	27.9	0.0612%	4.7%	0.000047%

Table notes: MMT = million metric tons. Global emissions estimates are from *International Energy Outlook 2010*, data for Figure 104, projected to 2040. Colorado emissions and statewide VMT estimates are from MOVES2010b.

## 6. Description of Alternatives

The I-70 East Supplemental Draft EIS examines potential effects to social, environmental, and economic resources resulting from proposed improvements to I-70 between I-25 and Tower Road. Consistent with federal regulations, the Supplemental Draft EIS fully evaluates potential effects that might result from the No-Action Alternative and the Build Alternatives (Revised Viaduct Alternative and Partial Cover Lowered Alternative). The alternatives and options are presented in Table 15.

For more detail on the alternatives and their options, see Attachment C, *Alternative Analysis Technical Report*.

**Table 15. Alternatives and Options**

Alternative		Expansion Options	Connectivity Options	Operational Options
No-Action		<ul style="list-style-type: none"> <li>• North</li> <li>• South</li> </ul>	N/A	N/A
Build Alternatives	Revised Viaduct	<ul style="list-style-type: none"> <li>• North</li> <li>• South</li> </ul>	N/A	<ul style="list-style-type: none"> <li>• General-Purpose Lanes</li> <li>• Managed Lanes</li> </ul>
	Partial Cover Lowered	N/A	<ul style="list-style-type: none"> <li>• Basic</li> <li>• Modified</li> </ul>	<ul style="list-style-type: none"> <li>• General-Purpose Lanes</li> <li>• Managed Lanes</li> </ul>

vehicle exhaust emissions of carbon dioxide (CO<sub>2</sub>) and other GHGs. However, only rudimentary information is available regarding the GHG emissions impacts of highway construction and maintenance. Estimation of GHG emissions from vehicle exhaust is subject to the same types of uncertainty affecting other types of air quality analysis, including imprecise information about current and future estimates of vehicle miles traveled, vehicle travel speeds, and the effectiveness of vehicle emissions control technology. Finally, there presently is no scientific methodology that can identify causal connections between individual source emissions and specific climate impacts at a particular location.

<sup>9</sup> These estimates are from the EIA's *International Energy Outlook 2010*, and are considered the best-available projections of emissions from fossil fuel combustion. These totals do not include other sources of emissions, such as cement production, deforestation, or natural sources; however, reliable future projections for these emissions sources are not available.

<sup>10</sup> MOVES projections suggest that Colorado motor vehicle CO<sub>2</sub> emissions may increase by 15.5% between 2010 and 2040; more stringent fuel economy/GHG emissions standards will not be sufficient to offset projected growth in VMT.

### No-Action Alternative

The No-Action Alternative replaces the existing viaduct between Brighton Boulevard and Colorado Boulevard without adding any capacity; the remainder of the corridor will reflect current conditions and include existing, planned, and programmed roadway and transit improvements (such as FasTracks) in the study area. The No-Action Alternative is shown in Figure 14.

**Figure 14. No-Action Alternative**



### Build Alternatives

Build Alternatives add capacity to I-70 by constructing additional lane(s) or restriping between I-25 and Tower Road.

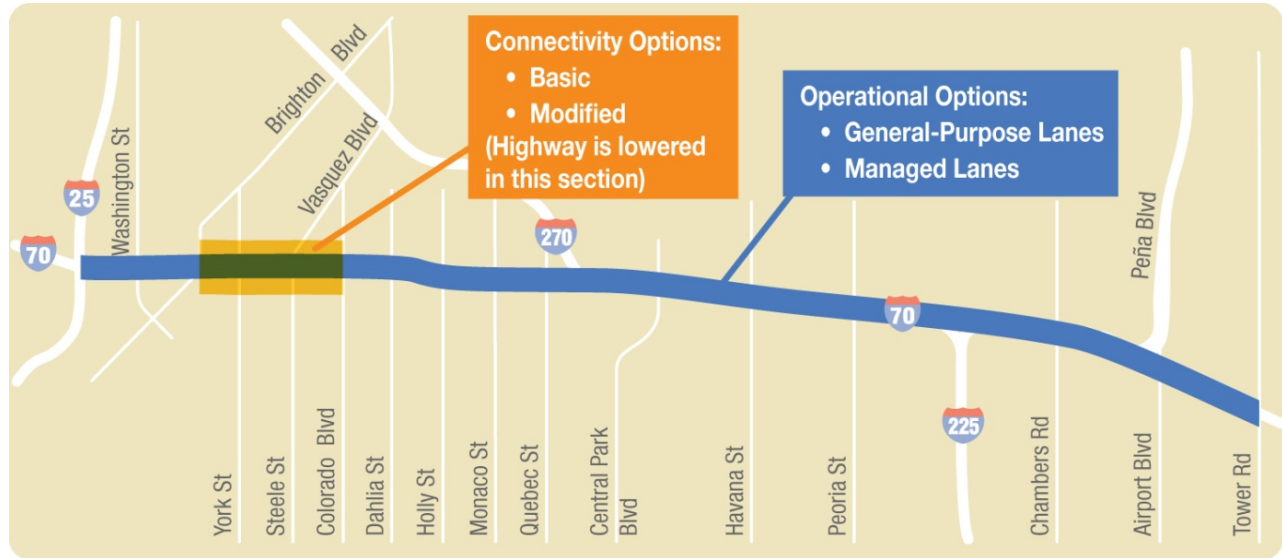
**Revised Viaduct Alternative.** The Revised Viaduct Alternative is shown in Figure 15. This alternative replaces the existing I-70 viaduct between Brighton Boulevard and Colorado Boulevard, while adding two additional lanes in each direction in this area. It also adds capacity to the rest of the corridor.

**Figure 15. Revised Viaduct Alternative**



**Partial Cover Lowered Alternative.** The Partial Cover Lowered Alternative is shown in Figure 16. This alternative removes the existing I-70 viaduct between Brighton Boulevard and Colorado Boulevard, lowering the highway below grade in this area, while adding two additional lanes in each direction. This alternative includes a cover over the highway between Clayton Street and Columbine Street. The alternative also adds capacity to the rest of the corridor.

**Figure 16. Partial Cover Lowered Alternative**



## Alternative Options

**Expansion Options.** Expansion Options, shown in Figure 15 and Figure 16 refer to moving the north edge of the highway north or the south edge of the highway south of the existing facility from Brighton Boulevard to Colorado Boulevard to accommodate the larger footprint resulting from standard width lanes, expanded shoulders, and construction phasing. These options apply to the No-Action Alternative and the Revised Viaduct Alternative. The Partial Cover Lowered Alternative does not include the Expansion Options because expansion of the highway can occur only on the north side due to engineering restrictions and the location of the UPRR rail yard to the south.

**Connectivity Options.** Connectivity Options are shown in Figure 16 and apply only to the Partial Cover Lowered Alternative. They include different frontage road and highway cover combinations. The Basic Option includes a highway cover between Clayton Street and Columbine Street, with 46th Avenue operating as a one-way road on each side of the highway (westbound on the north side and eastbound on the south side). The Modified Option removes the Steele Street/Vasquez Boulevard interchange to include an additional cover in the vicinity of Steele Street. 46th Avenue is designed as a two-way street on both the north and south sides of the highway; however, it is discontinued between Clayton Street and Columbine Street on the north side to allow for a seamless connection between Swansea Elementary School and the cover. Vehicular north/south connectivity across the highway at Josephine Street will be eliminated and replaced with a bike/pedestrian bridge. Additional connectivity and intersection improvements are discussed in Chapter 3, Summary of Project Alternatives.

**Operational Options.** Operational Options include two scenarios on how the additional capacity will be managed and operated. The General-Purpose Lanes Option will allow all vehicles to use all the lanes on the highway, while the Managed Lanes Option implements operational strategies (such as pricing) for the additional lanes that would be adjusted based on real-time traffic demand for vehicles that use these lanes. The additional lanes are separated with a four-foot buffer from the rest of the lanes under the Managed Lanes Option, and they have direct connections to I-225, I-270, and Peña Boulevard. Operational Options

apply to the Revised Viaduct Alternative and the Partial Cover Lowered Alternative, and they are shown in Figure 15 and Figure 16.

## 7. Effects Analysis

This chapter discusses the results of the air quality analysis and the effects of the alternatives on air quality. It is arranged in the following order of pollutant analyses:

- CO hotspot analysis
- PM<sub>10</sub> hotspot analysis
- Criteria pollutant emission inventories
- MSAT emission inventories
- GHG emission inventories

### 7.1. CO hotspot analysis

#### 7.1.1. Modeled results/CO hotspot design values

Table 16 and Figure 17 show the modeled 8-hour CO concentrations from CAL3QHC, the background CO concentrations provided by APCD, and the resulting total CO concentrations for each alternative for the morning and evening peak periods. According to Section 4.7.3 of the 1992 Guideline, total CO concentrations are calculated as the sum of the modeled intersection concentration and the background concentration attributable to other local emissions sources. Concentrations in the table are shown for the receptors with the highest levels inside the CO hotspot study area. Because not all of the alternatives were modeled with the DRCOG Compass model, it was necessary to estimate concentrations for some of the alternatives based on changes in traffic, speeds, and emissions relative to the alternatives that were modeled.

The Denver region originally received a nonattainment designation because of CO levels in 1978, when it exceeded both the 1-hour and 8-hour NAAQS limits for CO. The trends through the 1980s and mid-1990s, however, primarily exceeded only the 8-hour standard. The last time Denver exceeded the 1-hour standard occurred prior to 1990, according to the *Carbon Monoxide Maintenance Plan for the Denver Metropolitan Area* (Colorado Air Quality Control Commission, December 15, 2005). Because of this, the 8-hour standard is used as the basis for the CO hotspot analysis.

As the numbers in Table 16 indicate, the 8-hour design values resulting from the CO hotspot analysis are all well below the 8-hour NAAQS limit of 9.0 ppm. Since the CO hotspot analysis is a worst-case study, it is reasonable to conclude that the CO emissions at any intersection affected by the project would also be well below the NAAQS limit. These findings are consistent with the Denver Region's CO maintenance plan, which concludes that the area "... has had a continuous downward trend in CO levels since 1992."

The fundamental differences among the alternatives occur in the viaduct section between Brighton Boulevard and Colorado Boulevard. The CO hotspot study area at I-70 and Colorado Boulevard is located near the eastern end of the viaduct section. Based on results from the DRCOG Compass models, traffic at the intersection is essentially the same for all Build Alternatives. The primary differences in the total CO concentrations among alternatives are caused by the intersection geometries. This is why the CO concentrations are higher for the PCL Alternative than the Revised Viaduct Alternative. The No-Action Alternative has the lowest concentrations of any of the alternatives in 2035; but again, the total CO concentrations for all of the alternatives are well below the 8-hour NAAQS standard for CO.

It is noteworthy to repeat that the CO hotspot analysis used a worst-case scenario in which the 2035 VMT activity was multiplied by MOVES emissions factors that represent the year 2010. With regard to Section 116 of the Transportation Conformity Rule, based on the CO hotspot analysis and resulting total CO concentrations, the project will not cause new local violations of the NAAQS limits for CO, nor will it increase the severity or number of existing violations. Although these conformity tests are met through the quantitative analysis, the project must be included in the regional emissions analysis of a conforming transportation plan before a conformity determination can be made.

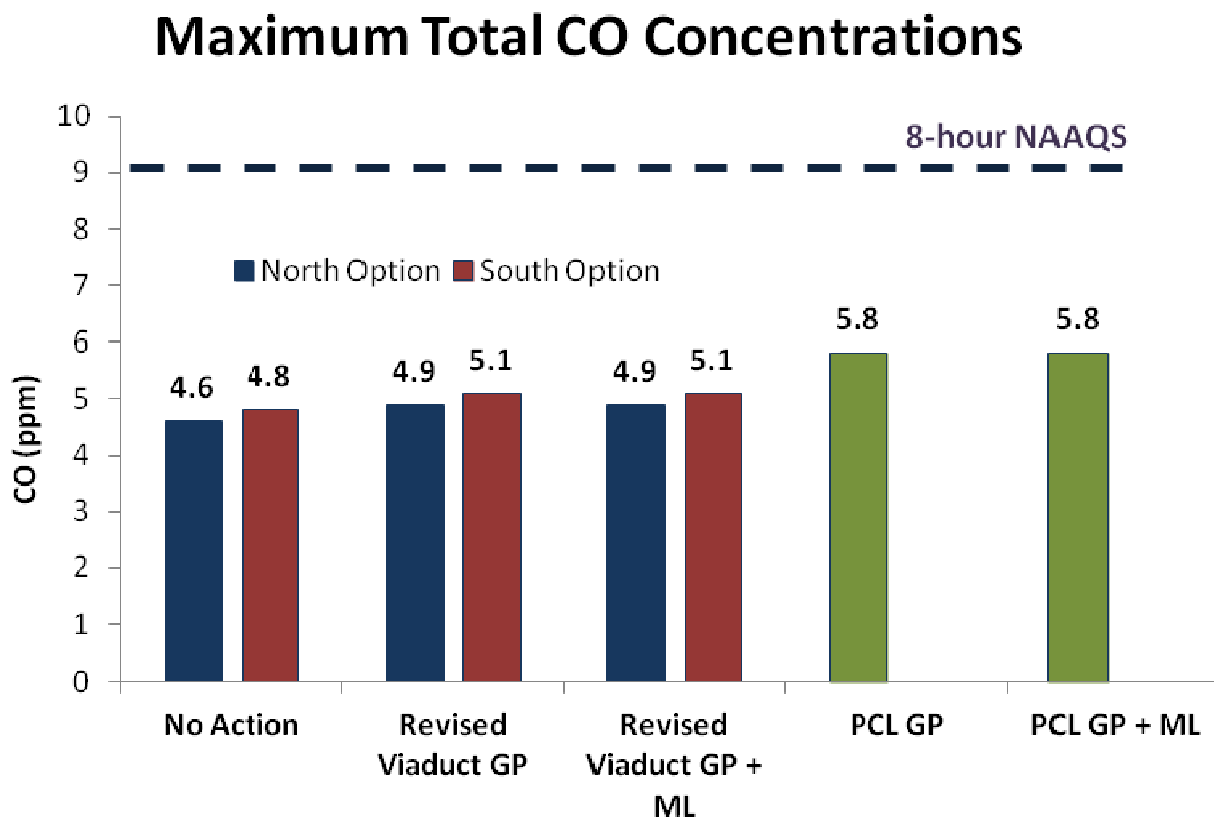
**Table 16. Results of the CO hotspot analysis, 8-hour CO concentrations (I-70 at Colorado Boulevard)**

Alternative Option	Period	General-Purpose Lanes Option		Managed Lanes Option	
		Modeled Concentration from CAL3QHC <sup>2</sup> (ppm)	Total CO Concentration (ppm) <sup>1</sup>	Modeled Concentration from CAL3QHC <sup>2</sup> (ppm)	Total CO Concentration (ppm) <sup>1</sup>
No-Action Alternative					
North Option	AM	1.6	4.6	N/A	N/A
	PM	1.6	4.6	N/A	N/A
South Option	AM	1.8	4.8	N/A	N/A
	PM	1.6	4.6	N/A	N/A
Revised Viaduct Alternative					
North Option	AM	1.9	4.9	2.7	5.7
	PM	1.9	4.9	2.3	5.3
South Option	AM	2.1	5.1	2.1	5.1
	PM	1.9	4.9	1.9	4.9
Partial Cover Lowered Alternative					
Basic Option	AM	2.8	5.8	2.8	5.8
	PM	2.6	5.6	2.6	5.6
Modified Option	AM	N/A	N/A	1.8	4.8
	PM	N/A	N/A	1.3	4.3

<sup>1</sup>A background concentration of 3.0 ppm was used to estimate total CO concentrations.

<sup>2</sup>Traffic from this model run was used for both the North and South options.

Figure 17. Results of the CO hotspot analysis, 8-hour CO concentration (I-70 at Colorado Boulevard)



#### 7.1.2. Sensitive receptors

Sensitive receptors include locations in the vicinity of a roadway that are likely to contain large numbers of populations who are most susceptible to the adverse effects of exposure to pollutants, such as hospitals, schools, child care facilities, and elder care facilities (EPA, 2013). Residential communities that are located in proximity to high-traffic freeways and roads also can be considered sensitive populations (California EPA, 2005).

The CO hotspot analysis models the location at which CO emission concentrations are expected to be greatest due primarily to the prevalence of idling vehicles at the interchange or intersection. For the CO hotspot analysis, this location was determined to be I-70 at Colorado Boulevard. As the results above demonstrate, the CO emissions concentrations for all of the No-Action and Build Alternatives are below the NAAQS limits.

There are no sensitive receptors within the I-70/Colorado Boulevard hotspot study area of which represents the highest concentration of CO in the study area. The hotspot study area consists of industrial and commercial facilities within the Elyria and Swansea Neighborhood.

Swansea Elementary School is the most notable concern for pollutant exposure because of its youth population, proximity to the highway, and frequency of outdoor activities. This school is located at Elizabeth Street between York Street and Steele Street/Vasquez Boulevard, just north of I-70 outside of the CO hotspot study area. Since the CO emission concentrations for all alternatives are below the NAAQS limit at all modeled receptor locations, it is reasonable to conclude that the carbon monoxide emissions at Swansea Elementary School also are below the NAAQS limit.

### 7.1.3. CO concentrations in the covered section

It is assumed that an emergency ventilation system will be part of the construction for the Partial Cover Lowered Alternative, operating primarily for smoke control if a fire were to break out in the covered section. The ventilation system also would be used in other emergencies, including incidents, accidents, and weather that could cause potentially high pollutant concentrations within the covered section. The ventilation system would be designed to operate automatically based on smoke and emissions sensors in the covered section.

An analysis was conducted to evaluate the need for a ventilation system based on the CO levels that motorists and/or workers may be exposed to under conditions of slowed or stopped traffic. The air quality analysis is part of a larger study that considers fire-based ventilation needs for the covered section. The report, *I-70 East Partial Cover Lowered Highway, Denver, Colorado—Covered and Depressed Sections Ventilated and Fire Life Safety Report* (Atkins, February 2013), documents the process and assumptions used to evaluate the CO conditions in the covered section. The report is included as Appendix E. The analysis assumed that all lanes of traffic are under stand-still conditions at full congested capacity. Pollution concentrations were estimated for the eastbound bore, since it represents the worst case because of the road gradient.

FHWA guidance, *Revised Guidelines for the Control of Carbon Monoxide Levels in Tunnels* (FHWA-HEV-30, March 31, 1989), establishes maximum CO levels in tunnels to protect the travelling public with an adequate margin of safety, as shown in Table 17.

**Table 17. Maximum carbon monoxide levels in tunnels**

Maximum CO Level (ppm)	Exposure Time (minutes)	Time-Based Exposure Limits (ppm-minutes)
120	15	1,800
65	30	1,950
45	45	2,025
35	60	2,100

Source: *Revised Guidelines for the Control of Carbon Monoxide Levels in Tunnels* (FHWA-HEV-30, March 31, 1989)

The maximum exposure limits and the exposure times in Table 17 were multiplied together to produce time-based exposure limits in units of ppm-minutes, which are also shown in the table. The 1,800 ppm-minute exposure limit is the most stringent, so it was applied in this analysis.

A MOVES-based analysis was used to produce the results shown in Table 18 for three pollutants. As the results indicate, there would be a need for a ventilation system based on the NO<sub>2</sub> concentrations within 27 minutes of stand-still conditions in the covered section. CO concentrations would warrant a ventilation system within 40 minutes of stopped traffic and NO concentrations within 60 minutes. Therefore, the NO<sub>2</sub> concentrations represent the worst case from an air quality perspective. In both cases, the time to reach the exposure limit is relatively short and would warrant the installation of a ventilation system regardless of fire safety needs. On the other hand, it would be a rare event to have full stand-still conditions for 40 minutes—or even for 27 minutes—within the 900-foot length of covered highway called for in the PCL Alternative.

**Table 18. Time to reach exposure limits**

Pollutant	Exposure Limit (ppm-minutes)	Time to Exposure Limit (minutes)
CO	1,800	40
NO	2251	60
NO <sub>2</sub>	102	27

<sup>1</sup> Source: *British Tunnelling Society guidance* (Institute of Occupational Medicine, 2006)

<sup>2</sup> Source: *Road Tunnels: Vehicle Emissions and Air Demand for Ventilation* (PIARC, 2012)

## 7.2. PM<sub>10</sub> hotspot analysis

### 7.2.1. PM<sub>10</sub> hotspot design values and conclusions

EPA's guidance (EPA-420-B-13-053) for calculating design values was applied for the PM<sub>10</sub> hotspot analysis; and the design values estimated through the hotspot analysis were compared against the NAAQS for PM<sub>10</sub>. Compliance with the 24-hour PM<sub>10</sub> NAAQS is based on the expected number of 24-hour exceedances of a particular level (currently 150 µg/m<sup>3</sup>), averaged over three consecutive years. Currently, the NAAQS is met when the expected number of exceedances is less than or equal to 1.0. The 24-hour PM<sub>10</sub> design value is rounded to the nearest 10 µg/m<sup>3</sup>. For example, 155.511 rounds to 160, and 154.999 rounds to 150. These rounding conventions were followed when calculating design values for the hotspot analysis. The contributions from the project, nearby sources, and background concentrations from other sources are combined to estimate 2035 emission concentrations (i.e., design values) at receptor locations in the two hotspot study areas.

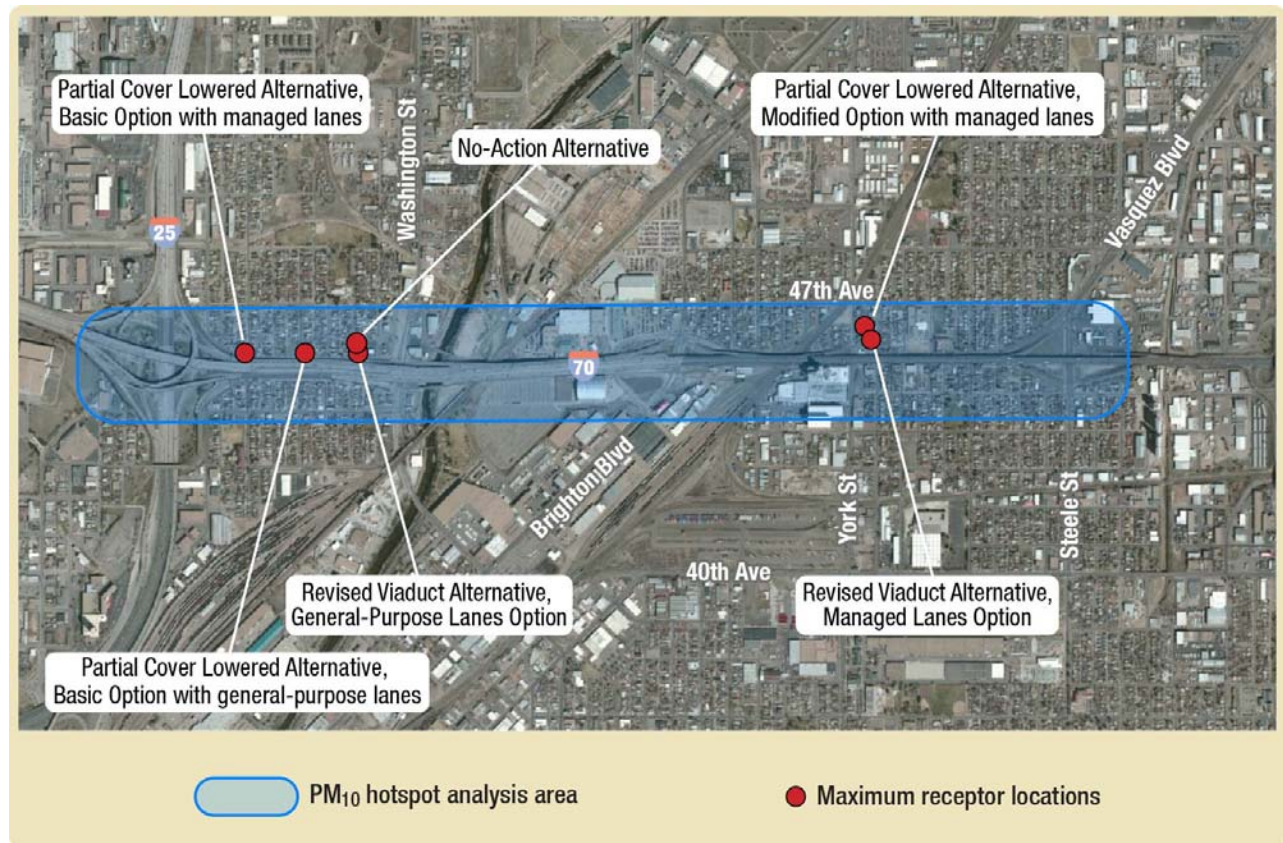
#### Design values

According to EPA guidance (EPA-420-B-13-053), the 24-hour PM<sub>10</sub> design value is calculated at each receptor by directly adding the sixth highest modeled 24-hour concentrations to the highest 24-hour background concentration recorded over the past three years of monitoring data. Table 19 and Table 20 contain the hotspot analysis results for the I-70/I-225 and I-70/I-25 locations, respectively. The modeled project emissions concentrations include exhaust, brake wear, and tire wear emissions from on-road vehicles and re-entrained road dust kicked up into the air by passing vehicles.

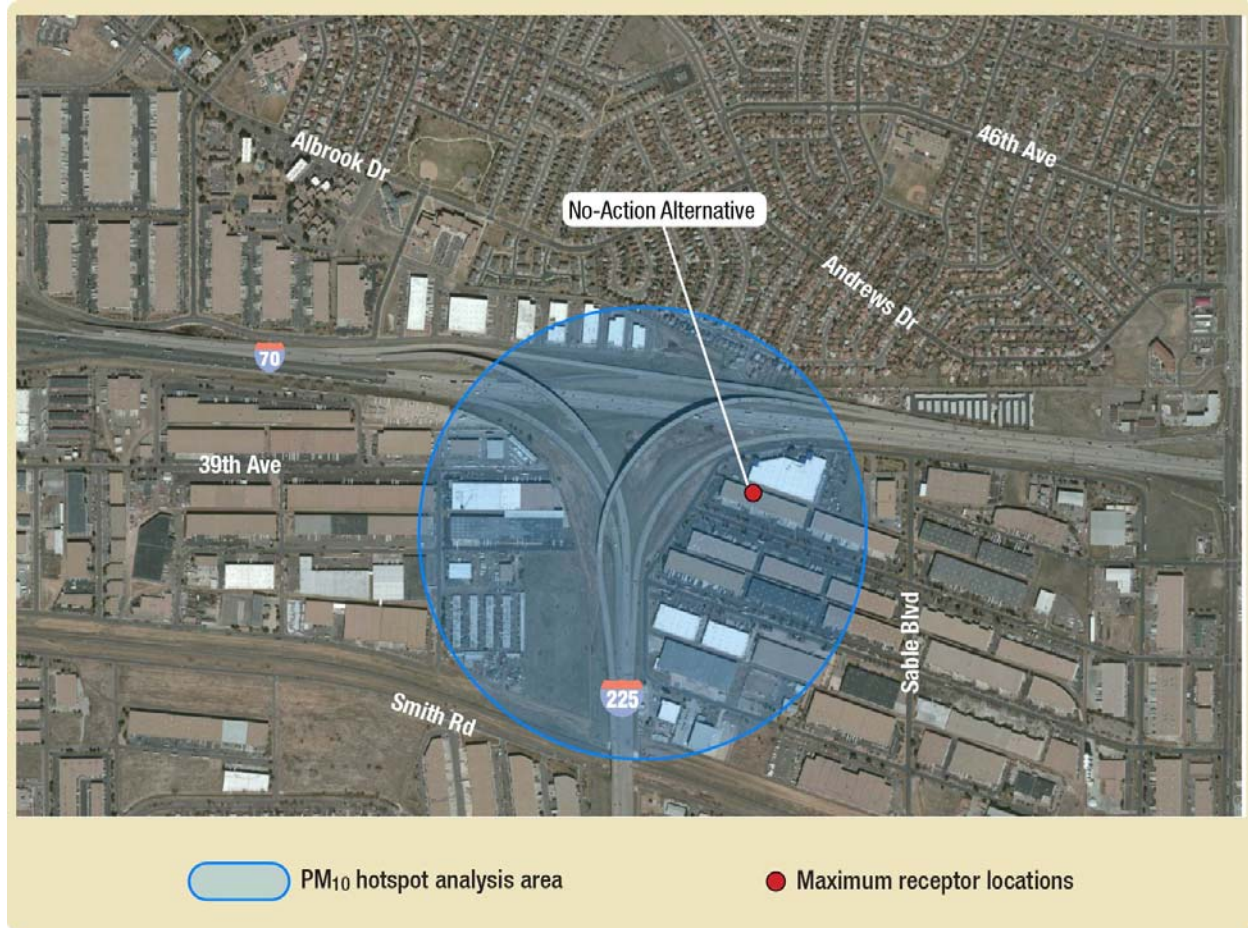
The fundamental differences among the alternatives occur in the viaduct section between Brighton Boulevard and Colorado Boulevard. As stated previously, the Pilot Travel Center is proposed to be closed as part of the Partial Cover Lowered Alternative and Revised Viaduct Alternative, North Option because the land is needed to accommodate the alternatives' footprints. This is relevant to the I-70/I-25 hotspot analysis because of the contribution of concentrated diesel emissions generated by idling trucks at the truck stop, which is located in close proximity to the I-70/I-25 PM<sub>10</sub> hotspot study area. However, since the truck stop is several miles away from the I-70/I-225 interchange, it was not included in the hotspot analysis for that location. In any case, the removal of the truck stop had a negligible impact on the emissions analysis at the I-25 hotspot location.

Locations of receptors showing maximum PM<sub>10</sub> concentration levels for vary throughout the I-25 PM<sub>10</sub> hotspot area depending on the alternative modeled (shown in Figure 18). Shown in Figure 19, the maximum receptor locations for PM<sub>10</sub> are the same as the No Action Alternative within the I-225 PM<sub>10</sub> hotspot area.

Figure 18. Receptors showing maximum PM<sub>10</sub> concentrations within the I-25 Hotspot Study Area



**Figure 19. Receptors showing maximum  $PM_{10}$  concentrations within the I-225 Hotspot Study Area**



**Table 19. Forecasted PM<sub>10</sub> concentrations for the I-70/I-225 hotspot analysis (µg/m<sup>3</sup>)**

Alternative	General Purpose Lanes <sup>2</sup>			Managed Lanes Option <sup>2</sup>		
	Modeled Project Concentration	Project + Background Concentration <sup>1</sup>	Design Value	Modeled Project Concentration	Project + Background Concentration <sup>1</sup>	Design Value
No-Action Alternative	32	145	140	N/A	N/A	N/A
Revised Viaduct Alternative	35	148	150	32	145	150
Partial Cover Lowered Alternative, Basic Option	37	150	150	38	151	150
Partial Cover Lowered Alternative, Modified Option	N/A	N/A	N/A	38*	151*	150*

<sup>1</sup>A background concentration of 113 µg/m<sup>3</sup> was used to estimate total 24-hour concentrations

<sup>2</sup>All Alternatives with the General-Purpose Lanes Option were modeled in Compass.

\* The Partial Cover Lowered Alternative, Modified Option was not modeled for I-70/I-225 because it has the same traffic volume and configuration as the Basic Option at this location.

**Table 20. Forecasted PM<sub>10</sub> concentrations for the I-70/I-25 hotspot analysis (µg/m<sup>3</sup>)**

Alternative	General Purpose Lanes <sup>2</sup>			Managed Lanes Option <sup>2</sup>		
	Modeled Project Concentration	Project + Background Concentration <sup>1</sup>	Design Value	Modeled Project Concentration	Project + Background Concentration <sup>1</sup>	Design Value
No-Action Alternative, North and South Options	37	150	150	N/A	N/A	N/A
Revised Viaduct Alternative, North and South Options	57	170	170	68	181	180
Partial Cover Lowered Alternative, Basic Option	60	173	170	38	151	150
Partial Cover Lowered Alternative, Modified Option	N/A	N/A	N/A	82	195	200

<sup>1</sup>A background concentration of 113 µg/m<sup>3</sup> was used to estimate total 24-hour concentrations

<sup>2</sup>All Alternatives with the General-Purpose Lanes Option were modeled in Compass.

Based on the numbers in Table 19 and Table 20, the results of the PM<sub>10</sub> hotspot analysis demonstrate that the No-Action Alternative and the Partial Cover Lowered Alternative, Basic Option with Managed Lanes Option would be in compliance with the applicable 24-hour NAAQS standard for PM<sub>10</sub>. These design values are less than or equal to the 24-hour PM<sub>10</sub> NAAQS of 150 µg/m<sup>3</sup>. The EPA's guidance (EPA-420-B-13-053) states that "... if the design value in the build scenario is less than or equal to the relevant PM NAAQS at appropriate receptors, then the project meets conformity requirements."

The other alternatives examined in this analysis, if implemented, would not be in compliance with the 24-hour NAAQS standard for PM<sub>10</sub> at the I-25 hotspot location. This is primarily due to distance from the alternatives to receptors, lane configuration, cover location(s), and VMT differences between the alternatives. Again, this PM<sub>10</sub> hotspot analysis was conducted to address community and agency concerns and not for transportation conformity purposes, but the stringent quantitative test required by the Conformity Rule provides assurances that neither the No-Action Alternative nor the Partial Cover Lowered Alternative, Basic Option with Managed Lanes Option would produce unhealthy PM<sub>10</sub> concentrations at any location within the corridor.

It is noteworthy to restate that the design values presented in Table 19 and Table 20 simulate worst-case conditions because they represent the highest PM<sub>10</sub> concentrations at the highest traffic volume locations in the corridor and in the year of peak emissions (2035). Therefore, it can be assumed that the PM<sub>10</sub> concentrations would be lower than these values at every possible receptor location throughout the corridor, including all schools, parks, open spaces, and other places.

Following completion of the PM hotspot modeling for all alternatives, FHWA and CDOT worked to investigate unexplained differences in VMT between the sets of links modeled for each alternative. The agencies found that the links modeled for each alternative were not selected consistently. Modeling for all alternatives includes the I-70 mainline links, major interchanges, and major crossing arterials. However, modeling for some alternatives include additional, smaller interchanges in the central portion of the project hotspot modeling area, while others do not include these interchanges; modeling for some of the alternatives included the lower-volume frontage roads, while others did not.

Under the EPA guidance for PM hotspot analysis, concentrations are rounded to the nearest 10 micrograms per cubic meter. Modeled concentrations are driven largely by the high traffic volumes on I-70 itself, and due to this rounding convention, addition of the missing frontage roads and small interchanges to the modeling for the remaining alternatives would not be expected to result in a change to the total concentrations reported in Tables 19 and 20.

However, CDOT will address these inconsistencies in revised modeling for the FEIS and the transportation conformity hotspot analysis, along with any other changes to the roadway links caused by revisions to the project between now and the FEIS. Finally, it should be noted that this VMT discrepancy does not affect the emissions inventories presented in the next section, as they were prepared independently of the hotspot analyses, and examined the entire project area.

### **Sensitive receptors**

Sensitive receptors include locations where populations are most susceptible to the adverse effects of exposure to pollutants related to transportation activities. Sensitive receptors include locations in the vicinity of a roadway that are most likely to contain large concentrations of sensitive populations, such as hospitals, schools, child care facilities, and elder care facilities (EPA, 2013). Residential communities that are located in proximity to high-traffic freeways and roads also can be considered sensitive populations (California EPA, 2005).

Sensitive receptors within the study area consist of schools, homes, and recreational facilities within the Elyria and Swansea Neighborhoods. Swansea Elementary School is the most notable concern for pollutant exposure because of its youth population, proximity to the freeway, and frequency of outdoor activities.

The PM<sub>10</sub> hotspot analysis models the location at which PM<sub>10</sub> emission concentrations are expected to be greatest. These locations were determined to be I-70/I-25 and I-70/I-225, as previously noted. As the results

demonstrate, the PM<sub>10</sub> emissions concentrations for all of the No-Action and Partial Cover Lowered Alternative, Basic Option with Managed Lanes Option are below the NAAQS limits.

Swansea Elementary School is located at Elizabeth Street between York Street and Vasquez Boulevard/Steele Street just north of I-70. It is within the I-70/I-25 PM<sub>10</sub> hotspot study area, so modeled pollutant concentrations are available for ten receptors located on the school property. As shown in Table 21, all of the modeled concentrations at the school are below the 24-hour PM<sub>10</sub> standard of 150 µg/m<sup>3</sup> and, therefore, are all in compliance with the NAAQS. As a reminder, the NAAQS defines primary and secondary limits for PM<sub>10</sub> based on human health and environment/property damage, respectively. In this case, the primary and secondary standards are both 150 µg/m<sup>3</sup>.

**Table 21. Forecasted PM<sub>10</sub> concentrations at Swansea Elementary School**

Receptor Number and Location	Forecasted 2035 PM <sub>10</sub> Concentrations (µg/m <sup>3</sup> ) <sup>1</sup>			
	No-Action Alternative	Revised Viaduct Alternative <sup>2</sup>	Partial Cover Lowered Alternative	
			Basic Option <sup>3</sup>	Modified Option
1. Playground southwest	138	N/A	121	144
2. School building southwest corner	134	N/A	121	139
3. Playground south	138	N/A	120	140
4. School building south edge	134	N/A	120	138
5. Playground southeast	138	N/A	120	135
6. Playground northeast	134	N/A	120	135
7. Columbine St.-- School Bus Loading Zone	131	136	132	148
8. Columbine St. Between 46 <sup>th</sup> and 47 <sup>th</sup> Ave.	128	133	131	145
9. Columbine St. and 47 <sup>th</sup> Ave.	126	128	128	143
10. Elizabeth St. Between 46 <sup>th</sup> and 47 <sup>th</sup> —Unpaved Parking lot across from school.	132	138	129	145

<sup>1</sup>Concentrations include project concentrations by alternative plus a background concentration of 113 µg/m<sup>3</sup>

<sup>2</sup>Values for the Revised Viaduct Alternative are not applicable because the receptor would be eliminated under this alternative

<sup>3</sup>General-Purpose Lanes Option has a slightly higher concentration at receptors 2 and 4 of 121

### 7.3. Criteria pollutant emission inventories

The emission inventories for the criteria pollutants were developed based on the previously described process and input data. The emissions inventories are based on vehicle traffic for the roadway segments included in DRCOG's Compass model and in the air quality study area shown in Figure 2. This includes all

roadway segments directly affected by the project, and additional roadway segments where traffic volumes would change as a result of the project alternatives. Because the analyses are designed to encompass the project study area, they also reflect traffic on some roadway segments that would not be affected by the project.

As a result, the emissions *totals* reported in this section of the Supplemental Draft EIS should be interpreted as representing motor vehicle emissions projected to occur within the study area, including both the roadways that are affected by the project and those that are not. Since all the freeway segments and most of the major streets in the study area do experience traffic volume changes as a result of the project alternatives, the majority of the emissions reported in this section do occur on roadways affected by the project. Also note that the *differences* in emissions between alternatives reported in the various exhibits below are solely due to the project.

The criteria pollutants are:

- Ozone
- Particulate matter
- Carbon monoxide
- Nitrogen oxides)
- Sulfur dioxide
- Lead

Ozone formation requires a complex chemical reaction of other pollutants to occur. It is discussed herein based on the inventories of its two primary precursor pollutants: nitrogen oxides and volatile organic compounds. Lead has been completely phased out of motor vehicle fuels in the United States and is no longer a vehicle emission concern, so no inventories were prepared for that pollutant.

The 2010, 2015, and 2020 emissions are the same for all alternatives for any given pollutant. Future Build conditions begin after opening day and are reflected in the 2025, 2030, and 2035 emissions in the table and exhibits in this section.

It is worth noting that these emissions inventories do not include the effects of EPA's recently finalized Tier 3 emissions standards, which are projected to reduce emissions of individual criteria and hazardous air pollutants by as much as 10-56% (EPA, 2014).

### **7.3.1. Particulate matter**

Table 22, Table 23, Figure 20, and Figure 21 show the values for the PM<sub>2.5</sub> and PM<sub>10</sub> emission inventories. From 2010 forward, both pollutants trend downward, due primarily to the cleaner standards for diesel engines, until about 2025 or 2030, when they trend higher as vehicular travel growth overtakes the technology-based emission reductions. Although there are minor differences in emissions among the No-Action and Build Alternatives, there is no real discernible difference, since they are all very close in any given year. Therefore, the particulate matter emissions are not a discriminating factor in the selection of a preferred alternative.

**Table 22. PM<sub>2.5</sub> emission inventories (tons per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	0.77	0.77	0.77	0.77	0.77	0.77
2015	0.52	0.52	0.52	0.52	0.52	0.52
2020	0.40	0.40	0.40	0.40	0.40	0.40
2025	0.37	0.37	0.37	0.37	0.36	0.36
2030	0.37	0.38	0.38	0.38	0.37	0.37
2035	0.39	0.40	0.40	0.40	0.39	0.39
<b>July</b>						
2010	0.54	0.54	0.54	0.54	0.54	0.54
2015	0.34	0.34	0.34	0.34	0.34	0.34
2020	0.24	0.24	0.24	0.24	0.24	0.24
2025	0.20	0.20	0.20	0.20	0.20	0.20
2030	0.20	0.20	0.20	0.20	0.20	0.20
2035	0.21	0.21	0.21	0.21	0.21	0.21

**Table 23. PM<sub>10</sub> emission inventories (tons per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	0.95	0.95	0.95	0.95	0.95	0.95
2015	0.71	0.71	0.71	0.71	0.71	0.71
2020	0.62	0.62	0.62	0.62	0.62	0.62
2025	0.62	0.62	0.62	0.62	0.60	0.60
2030	0.65	0.65	0.65	0.65	0.64	0.64
2035	0.70	0.70	0.70	0.70	0.68	0.68
<b>July</b>						
2010	0.70	0.70	0.70	0.70	0.70	0.70
2015	0.52	0.52	0.52	0.52	0.52	0.52
2020	0.44	0.44	0.44	0.44	0.44	0.44
2025	0.44	0.43	0.42	0.43	0.43	0.42
2030	0.46	0.45	0.45	0.46	0.45	0.44
2035	0.50	0.49	0.48	0.49	0.48	0.48

Figure 20. PM<sub>2.5</sub> emission inventories (tons per day)

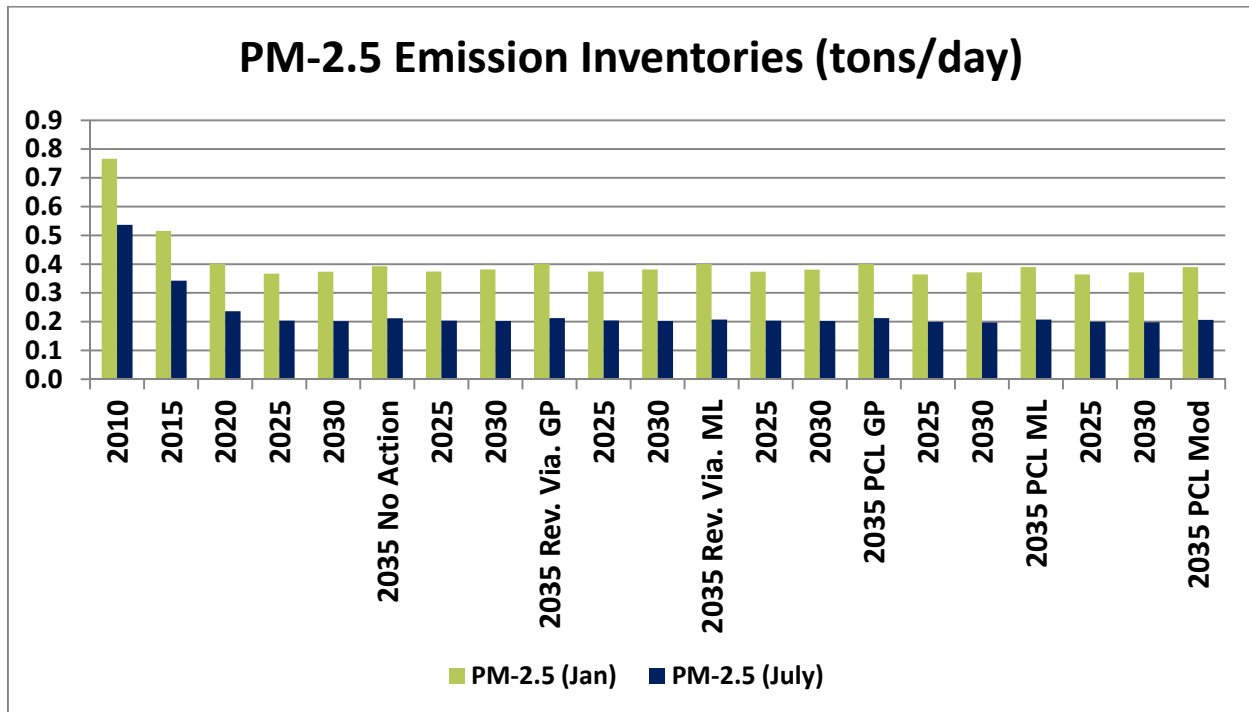
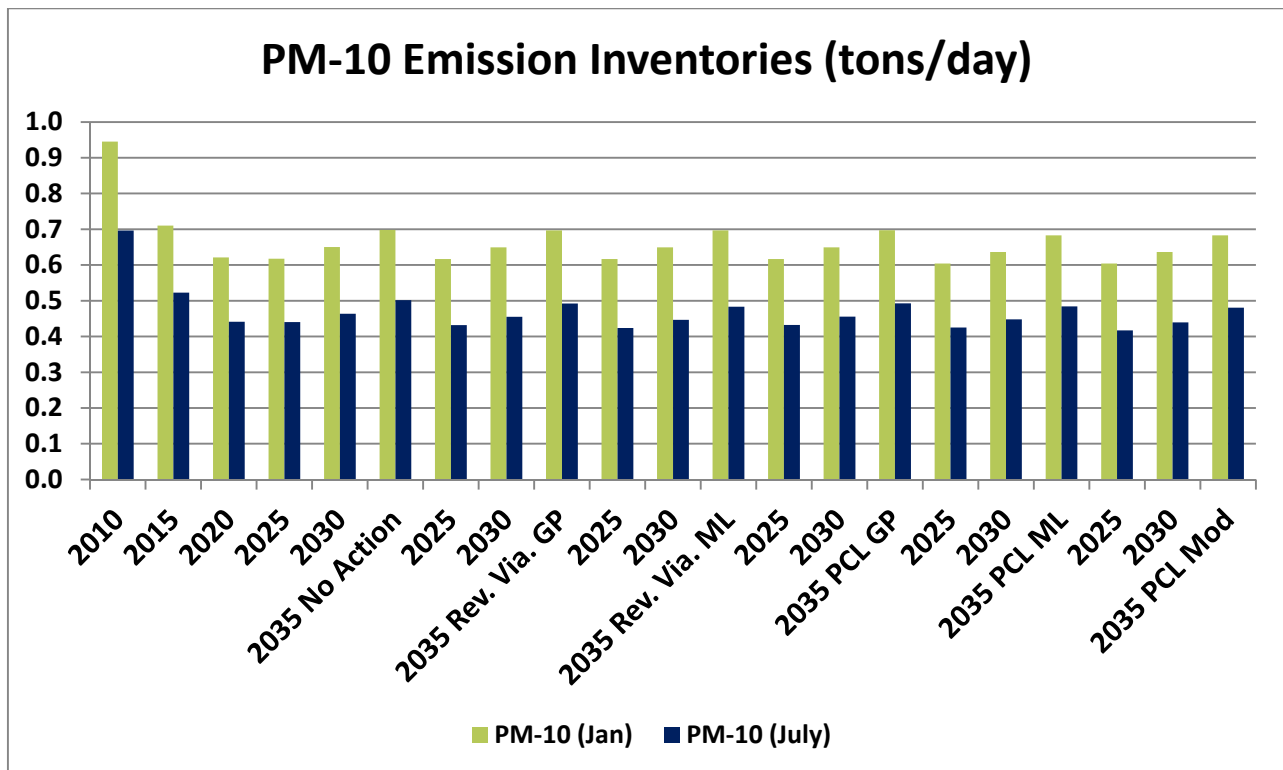


Figure 21. PM<sub>10</sub> emission inventories (tons per day)



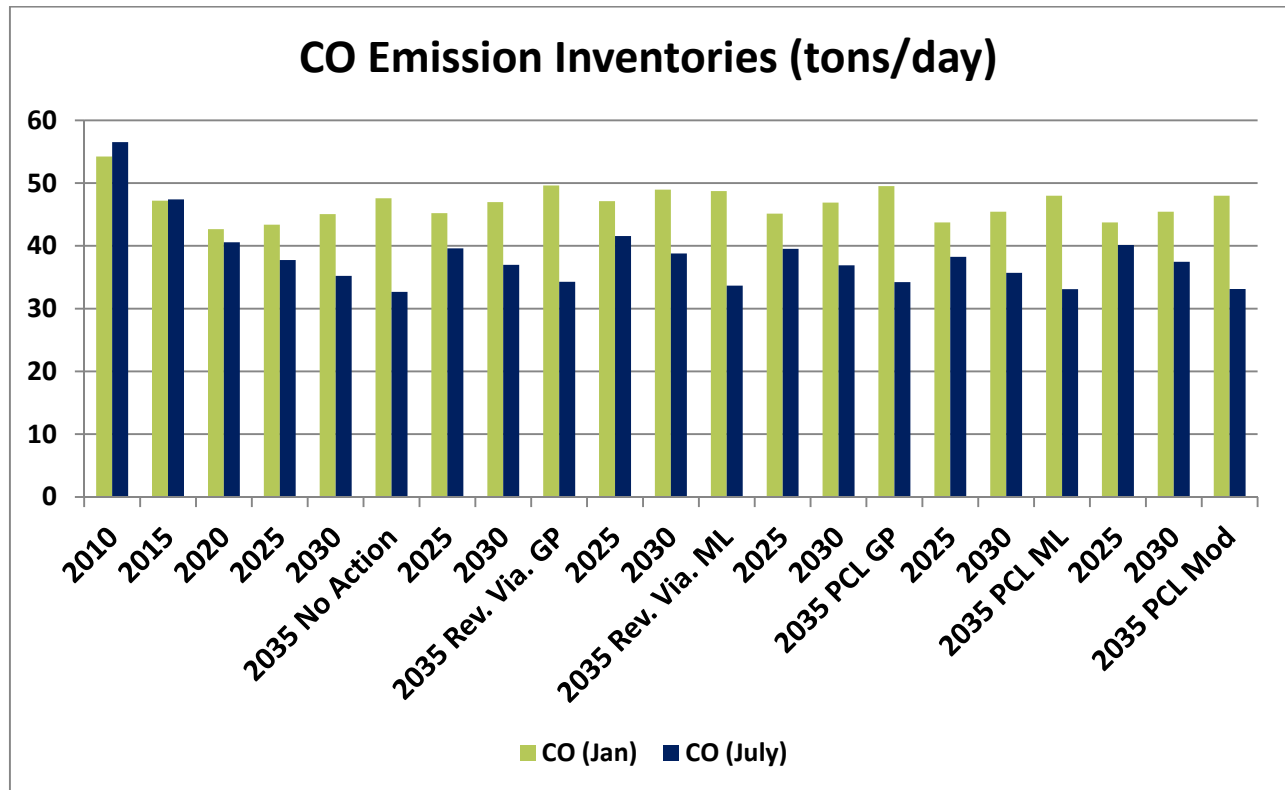
### 7.3.2. Carbon monoxide

Table 24 and Figure 22 show the CO emission inventories. In almost all cases, the January emissions are shown to be higher than July emissions because of differing fuel specifications. The July emissions trend down from 2010 to 2035 largely because of fuel economy standards and engine technology. However, the January emissions show a different trend, as they begin to increase after 2020. This is explained by an increasing affect of engine cold starts in the colder months. There are minor differences in emissions among the alternatives in any given year, and the No-Action and PCL—ML alternatives have slightly lower CO emissions than the General-Purpose Lanes Options, but the differences are small. Therefore, CO is not a discriminating factor in the selection of a preferred alternative.

**Table 24. CO emission inventories (tons per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	54.2	54.2	54.2	54.2	54.2	54.2
2015	47.2	47.2	47.2	47.2	47.2	47.2
2020	42.7	42.7	42.7	42.7	42.7	42.7
2025	43.4	45.2	47.1	45.1	43.7	43.7
2030	45.0	47.0	49.0	46.9	45.4	45.4
2035	47.6	49.6	48.7	49.5	48.0	48.0
<b>July</b>						
2010	56.5	56.5	56.5	56.5	56.5	56.5
2015	47.4	47.4	47.4	47.4	47.4	47.4
2020	40.6	40.6	40.6	40.6	40.6	40.6
2025	37.7	39.6	41.6	39.5	38.2	40.1
2030	35.2	37.0	38.8	36.9	35.7	37.5
2035	32.7	34.3	33.7	34.2	33.1	33.1

Figure 22. CO emission inventories (tons per day)



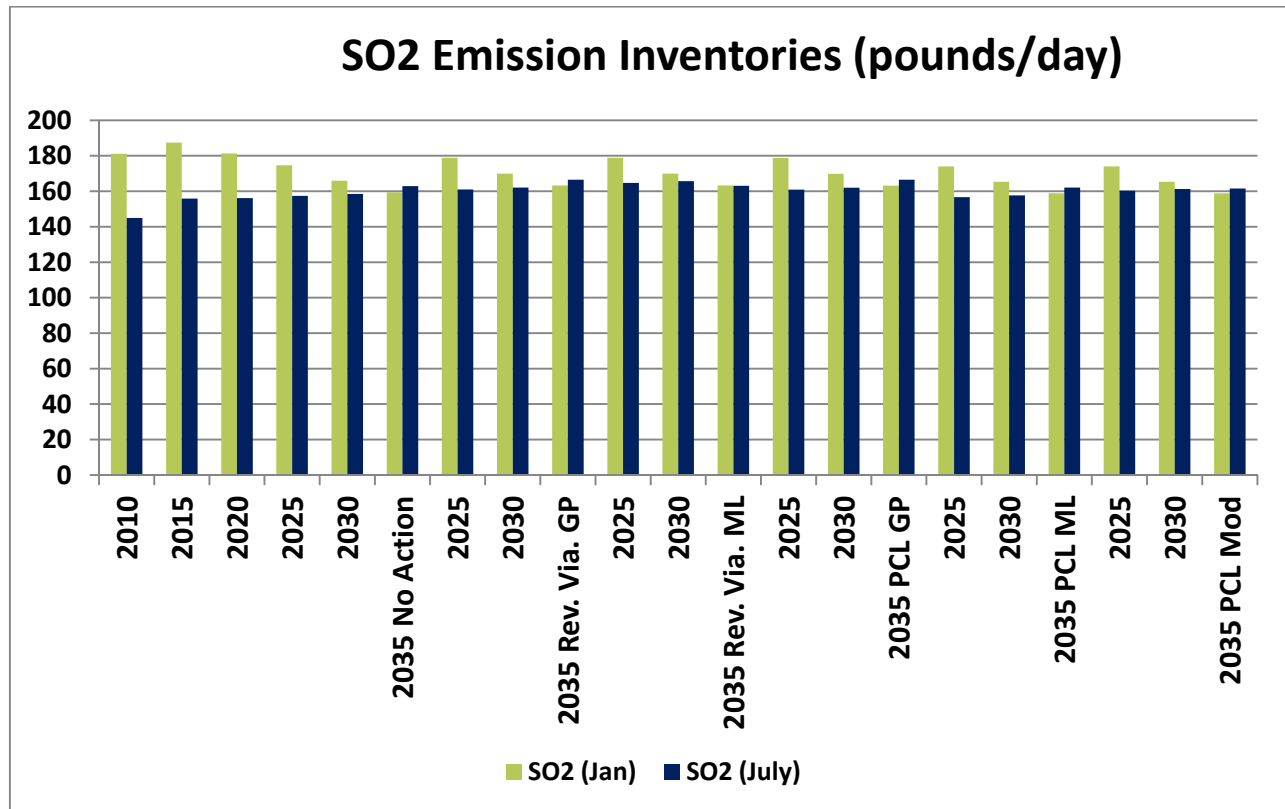
### 7.3.3. Sulfur dioxide

Table 25 and Figure 23 show the SO<sub>2</sub> emission inventories. In all years except 2035, the January emissions are higher than the July results. The July emissions display a slight upward trend from 2010 through 2035, whereas the January emissions peak in 2020, then begin a downward trend. There are minor differences in emissions among the alternatives in any given year, and the No-Action and PCL—ML alternatives have slightly lower SO<sub>2</sub> emissions than the General-Purpose Lanes Options, but the differences are minimal, so SO<sub>2</sub> is not a discriminating factor in the selection of a preferred alternative.

**Table 25. SO<sub>2</sub> emission inventories (tons per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	181	181	181	181	181	181
2015	187	187	187	187	187	187
2020	181	181	181	181	181	181
2025	175	179	179	179	174	174
2030	166	170	170	170	165	165
2035	159	163	163	163	159	159
<b>July</b>						
2010	145	145	145	145	145	145
2015	156	156	156	156	156	156
2020	156	156	156	156	156	156
2025	157	161	165	161	157	160
2030	158	162	166	162	158	161
2035	163	167	163	166	162	162

Figure 23. SO<sub>2</sub> emission inventories (tons per day)



### 7.3.4. Ozone

Emission inventories for the ozone precursor emission nitrogen oxides are shown in Table 26 and Figure 24. The inventories for the other primary precursor, volatile organic compounds, are shown in Table 27 and Figure 25. Since ozone is formed in the presence of sunlight through a chemical reaction of these two precursors, it is only possible to report trends for the two precursor pollutants and infer what effect these may have on ozone levels. Emissions of both nitrogen oxides and volatile organic compounds trend downward from 2010 through 2035. Therefore, the on-road motor vehicle contribution to the ozone problem is decreasing over time, which would likely result in lower ozone levels, but that depends on the precursor emission trends from other sources.

**Table 26. NOx emission inventories (tons per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	15.9	15.9	15.9	15.9	15.9	15.9
2015	10.0	10.0	10.0	10.0	10.0	10.0
2020	6.4	6.4	6.4	6.4	6.4	6.4
2025	4.9	5.1	5.3	5.1	4.8	4.8
2030	4.1	4.3	4.4	4.3	4.1	4.1
2035	3.6	3.7	3.6	3.7	3.6	3.6
<b>July</b>						
2010	15.2	15.2	15.2	15.2	15.2	15.2
2015	9.8	9.8	9.8	9.8	9.8	9.8
2020	6.5	6.5	6.5	6.5	6.5	6.5
2025	5.0	5.2	5.3	5.1	4.9	5.1
2030	4.2	4.3	4.5	4.3	4.2	4.3
2035	3.7	3.8	3.6	3.8	3.6	3.6

Figure 24. NOx emission inventories (tons per day)

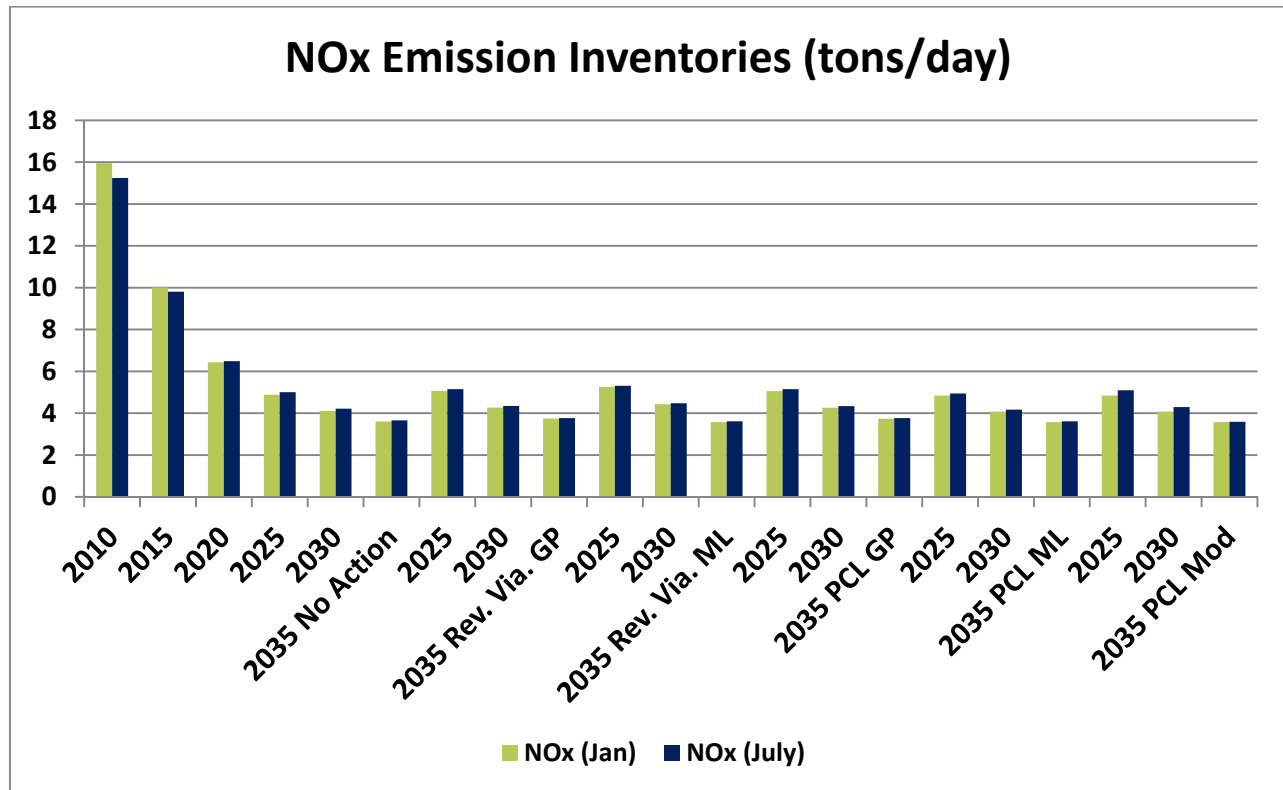
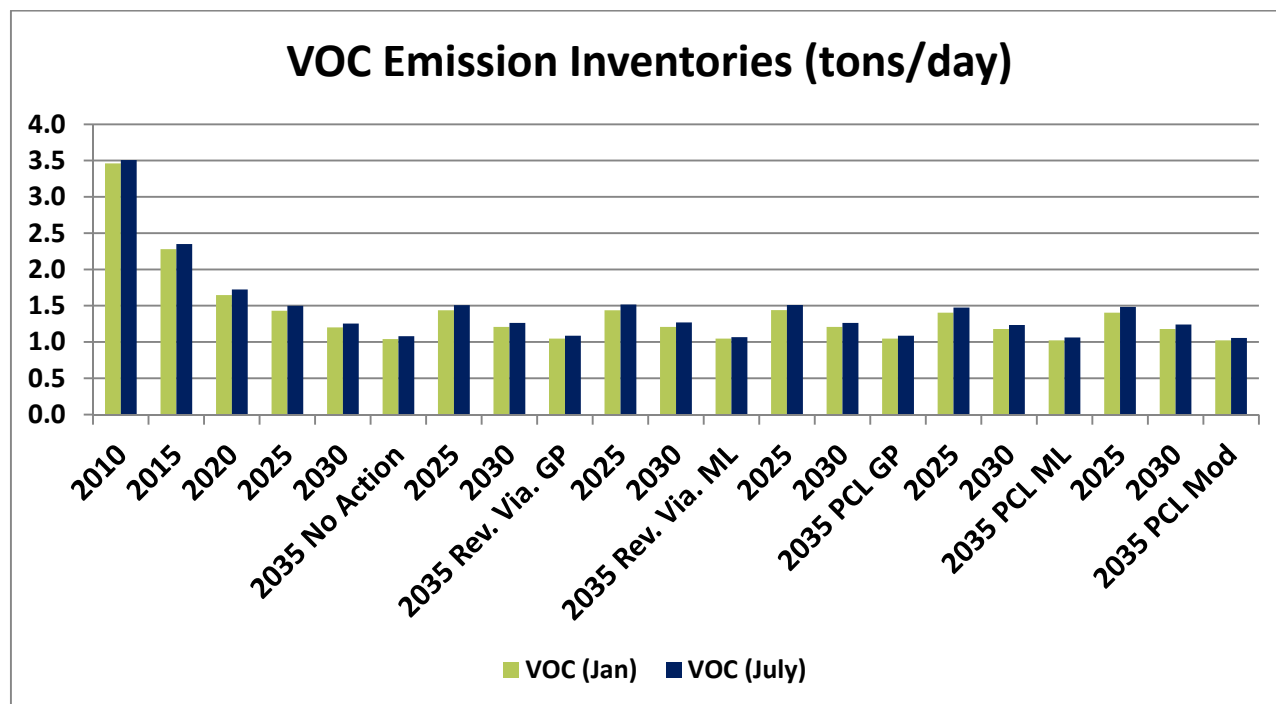


Table 27. VOC emission inventories (tons per day)

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
January						
2010	3.46	3.46	3.46	3.46	3.46	3.46
2015	2.28	2.28	2.28	2.28	2.28	2.28
2020	1.65	1.65	1.65	1.65	1.65	1.65
2025	1.43	1.44	1.44	1.44	1.41	1.41
2030	1.20	1.21	1.21	1.21	1.18	1.18
2035	1.04	1.05	1.05	1.05	1.02	1.02
July						
2010	3.51	3.51	3.51	3.51	3.51	3.51
2015	2.35	2.35	2.35	2.35	2.35	2.35
2020	1.72	1.72	1.72	1.72	1.72	1.72
2025	1.50	1.51	1.52	1.51	1.47	1.48
2030	1.26	1.26	1.27	1.26	1.23	1.24
2035	1.08	1.09	1.07	1.09	1.06	1.06

Figure 25. VOC emission inventories (tons per day)



## 7.4. Mobile source air toxics emission inventories

The emission inventories for the MSAT pollutants were developed based on the previously described process and input data. Of the 21 MSATs, EPA has indicated that the majority of adverse health effects arise from seven pollutants, which FHWA has labeled as priority MSATs for NEPA studies. The pollutants are:

- Benzene
- Formaldehyde
- Naphthalene
- Diesel particulate matter (DPM)/diesel exhaust organic gases
- Acrolein
- 1,3 butadiene
- Polycyclic organic matter

Based on FHWA's analysis using EPA's air quality models, DPM is the MSAT of the most concern.

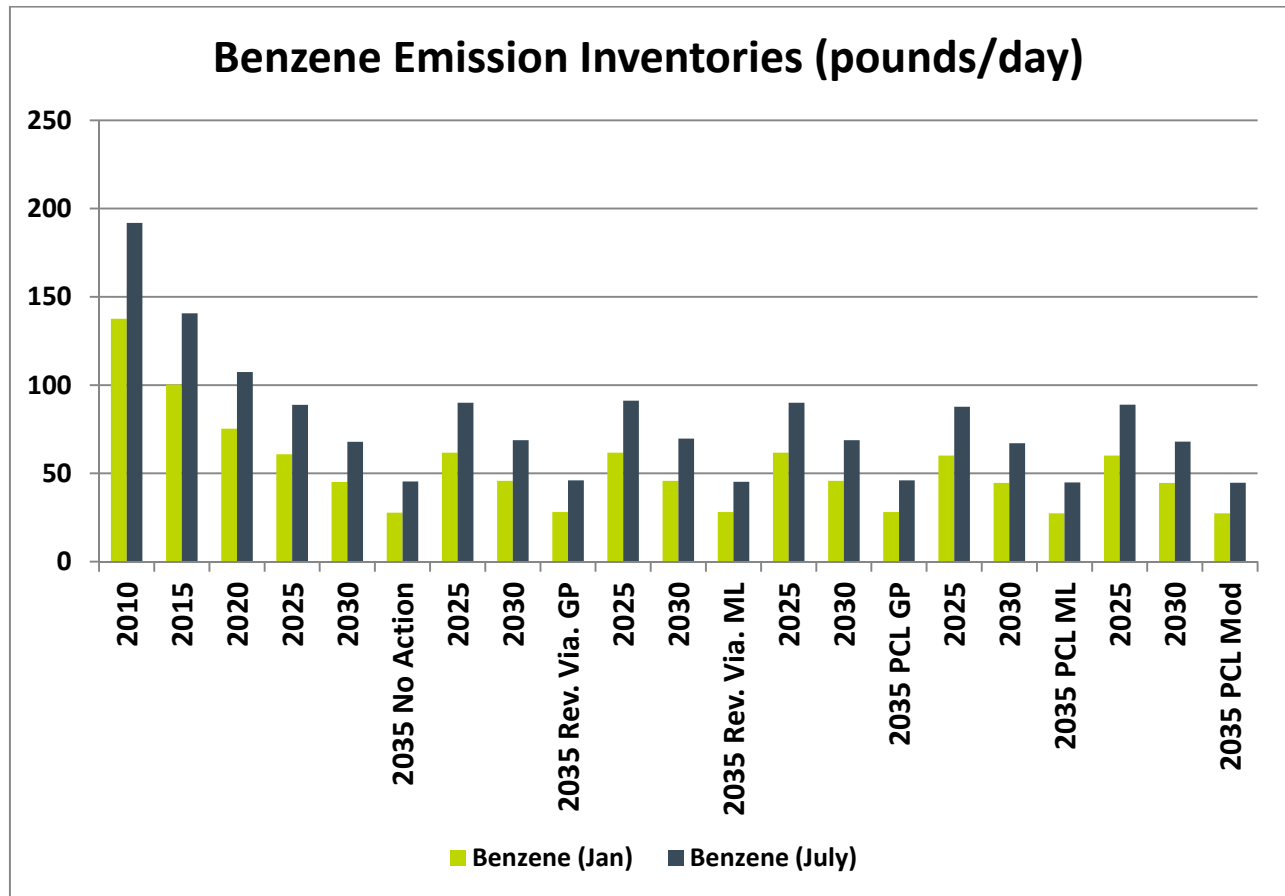
### 7.4.1. Benzene

Table 28 and Figure 26 show the benzene emission inventories. July emissions are higher than January emissions in all cases because of benzene's evaporative properties. In all cases, emissions are showing a downward trend from 2010 through 2035. There are no discernible differences in emissions among alternatives in any given year, so benzene is not a discriminating factor in the selection of a preferred alternative.

**Table 28. Benzene emission inventories (pounds per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	137.57	137.57	137.57	137.57	137.57	137.57
2015	100.28	100.28	100.28	100.28	100.28	100.28
2020	75.29	75.29	75.29	75.29	75.29	75.29
2025	60.83	61.69	61.69	61.70	60.08	60.08
2030	45.16	45.80	45.80	45.81	44.61	44.61
2035	27.72	28.11	28.11	28.11	27.37	27.37
<b>July</b>						
2010	191.85	191.85	191.85	191.85	191.85	191.85
2015	140.66	140.66	140.66	140.66	140.66	140.66
2020	107.36	107.36	107.36	107.36	107.36	107.36
2025	88.78	89.95	91.14	89.97	87.74	88.90
2030	67.89	68.79	69.70	68.80	67.10	67.98
2035	45.41	46.00	45.18	46.01	44.88	44.69

Figure 26. Benzene emission inventories (pounds per day)



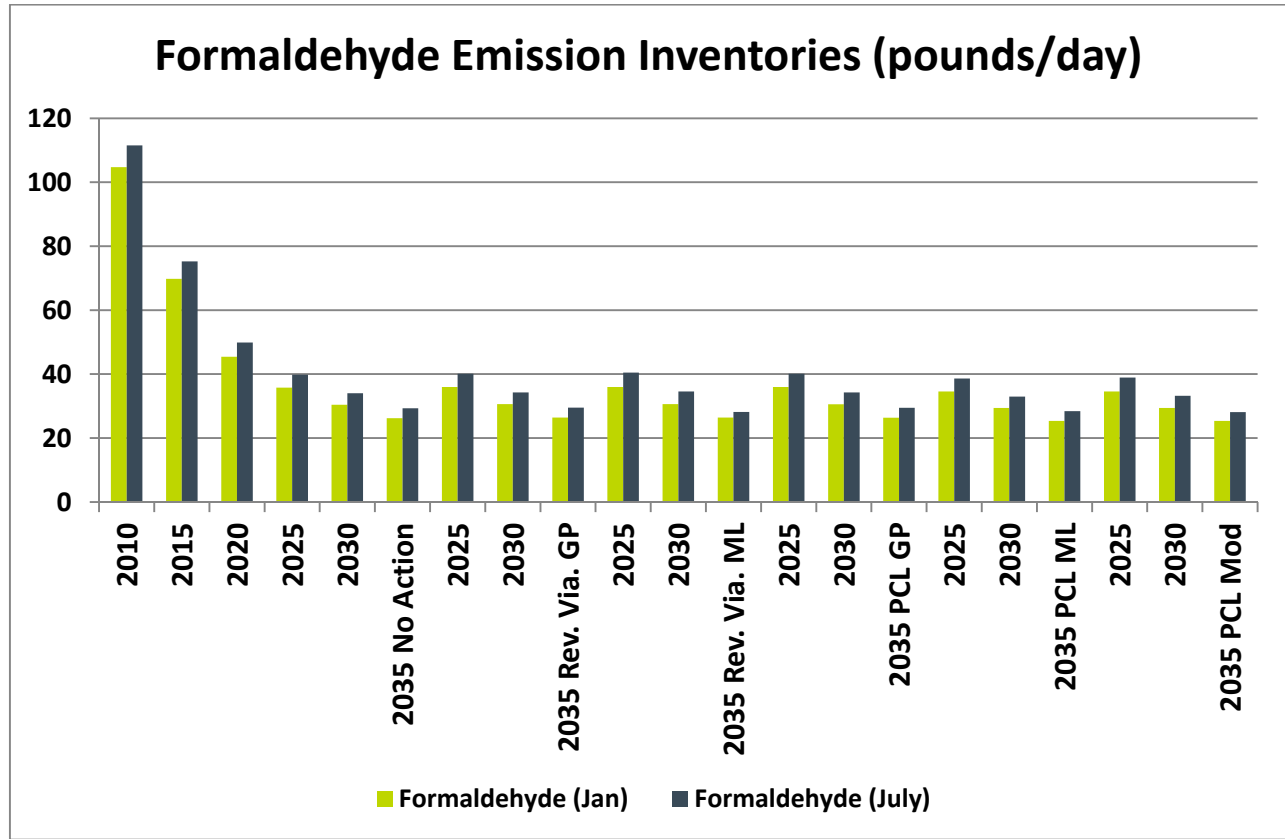
### 7.4.2. Formaldehyde

Table 29 and Figure 27 show the formaldehyde emission inventories. July emissions are higher than January emissions in all cases because of formaldehyde's evaporative properties. In all cases, emissions are showing a downward trend from 2010 through 2035. There are no discernible differences in emissions among alternatives in any given year, so formaldehyde is not a discriminating factor in the selection of a preferred alternative.

**Table 29. Formaldehyde emission inventories (pounds per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	104.72	104.72	104.72	104.72	104.72	104.72
2015	69.81	69.81	69.81	69.81	69.81	69.81
2020	45.41	45.41	45.41	45.41	45.41	45.41
2025	35.77	35.99	35.99	35.95	34.56	34.56
2030	30.44	30.63	30.63	30.59	29.41	29.41
2035	26.23	26.40	26.40	26.37	25.35	25.35
<b>July</b>						
2010	111.51	111.51	111.51	111.51	111.51	111.51
2015	75.24	75.24	75.24	75.24	75.24	75.24
2020	49.90	49.90	49.90	49.90	49.90	49.90
2025	39.84	40.14	40.45	40.10	38.61	38.91
2030	34.02	34.29	34.55	34.25	32.98	33.23
2035	29.29	29.52	28.18	29.49	28.39	28.12

Figure 27. Formaldehyde emission inventories (pounds per day)



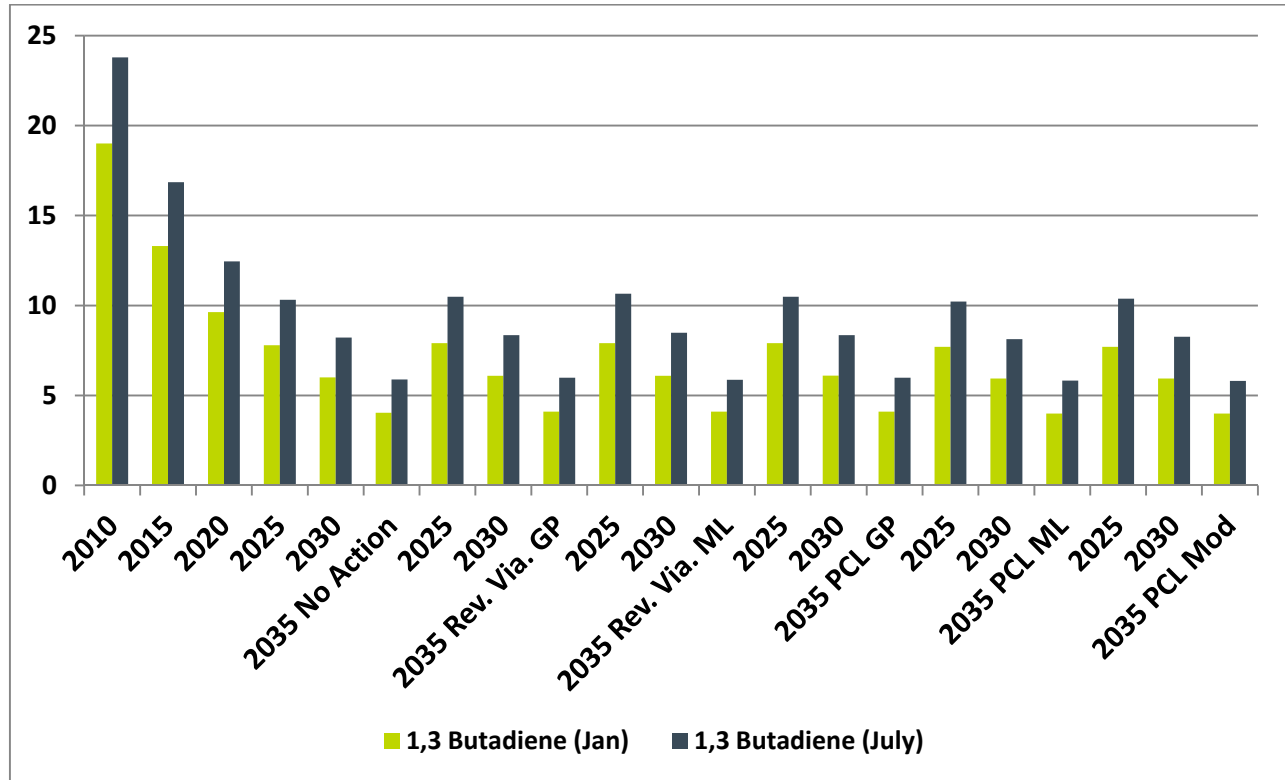
### 7.4.3. 1,3 Butadiene

Table 30 and Figure 28 show the 1,3 Butadiene emission inventories. July emissions are higher than January emissions in all cases because of 1,3 Butadiene's evaporative properties. In all cases, emissions are showing a downward trend from 2010 through 2035. There are no discernible differences in emissions among alternatives in any given year, so 1,3 Butadiene is not a discriminating factor in the selection of a preferred alternative.

**Table 30. 1,3 Butadiene emission inventories (pounds per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	19.0	19.0	19.0	19.0	19.0	19.0
2015	13.3	13.3	13.3	13.3	13.3	13.3
2020	9.6	9.6	9.6	9.6	9.6	9.6
2025	7.8	7.9	7.9	7.9	7.7	7.7
2030	6.0	6.1	6.1	6.1	5.9	5.9
2035	4.0	4.1	4.1	4.1	4.0	4.0
<b>July</b>						
2010	23.8	23.8	23.8	23.8	23.8	23.8
2015	16.9	16.9	16.9	16.9	16.9	16.9
2020	12.5	12.5	12.5	12.5	12.5	12.5
2025	10.3	10.5	10.7	10.5	10.2	10.4
2030	8.2	8.3	8.5	8.4	8.1	8.3
2035	5.9	6.0	5.9	6.0	5.8	5.8

Figure 28. 1,3 Butadiene emission inventories (pounds per day)



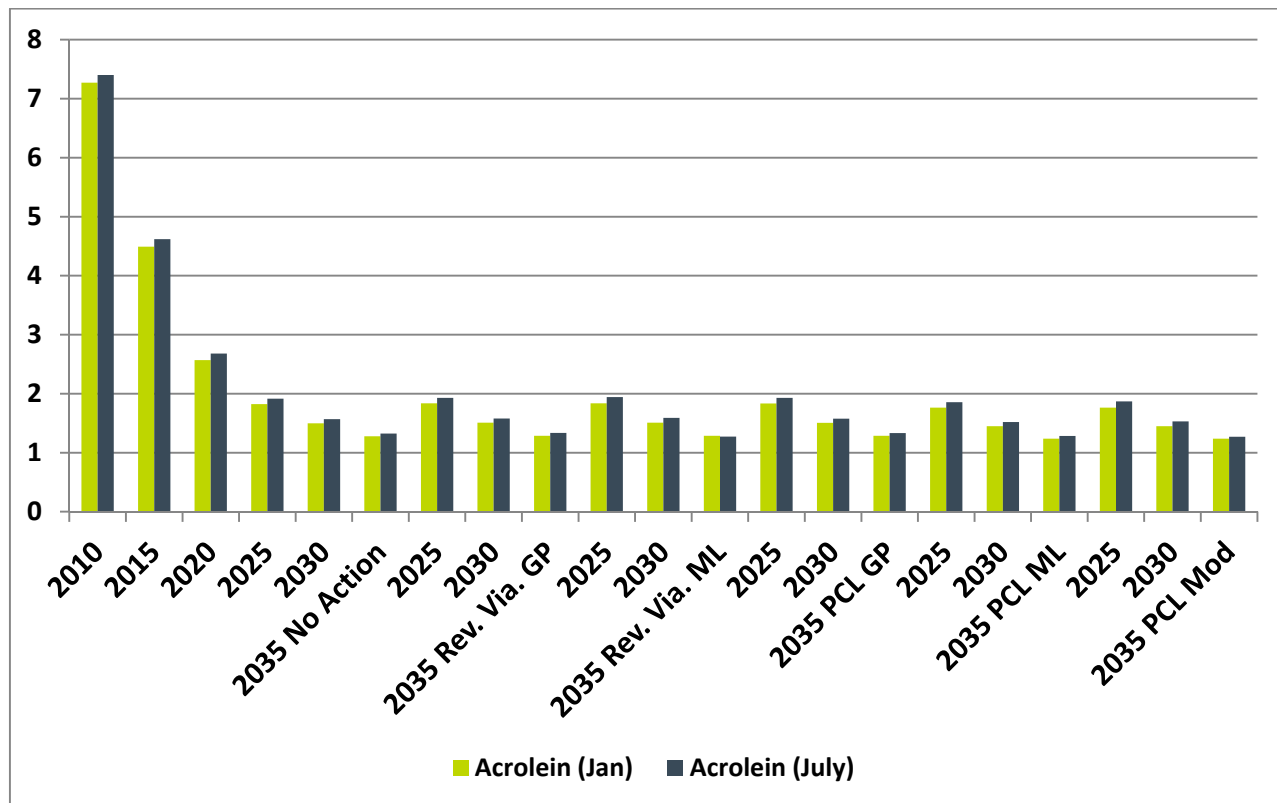
#### 7.4.4. Acrolein

Table 31 and Figure 29 show the acrolein emission inventories. July emissions are slightly higher than January emissions in all cases because of acrolein's evaporative properties. In all cases, emissions are showing a downward trend from 2010 through 2035. There are no discernible differences in emissions among alternatives in any given year, so acrolein is not a discriminating factor in the selection of a preferred alternative.

**Table 31. Acrolein emission inventories (pounds per day)**

Year	No-Action	Revised Viaduct— GP	Revised Viaduct— ML	PCL—GP	PCL— GP+ML	PCL—Mod
<b>January</b>						
2010	7.27	7.27	7.27	7.27	7.27	7.27
2015	4.49	4.49	4.49	4.49	4.49	4.49
2020	2.57	2.57	2.57	2.57	2.57	2.57
2025	1.82	1.84	1.84	1.83	1.76	1.76
2030	1.50	1.51	1.51	1.51	1.45	1.45
2035	1.28	1.29	1.29	1.29	1.24	1.24
<b>July</b>						
2010	7.40	7.40	7.40	7.40	7.40	7.40
2015	4.62	4.62	4.62	4.62	4.62	4.62
2020	2.68	2.68	2.68	2.68	2.68	2.68
2025	1.92	1.93	1.94	1.93	1.86	1.87
2030	1.57	1.58	1.59	1.58	1.52	1.53
2035	1.33	1.34	1.27	1.33	1.28	1.27

Figure 29. Acrolein emission inventories (pounds per day)



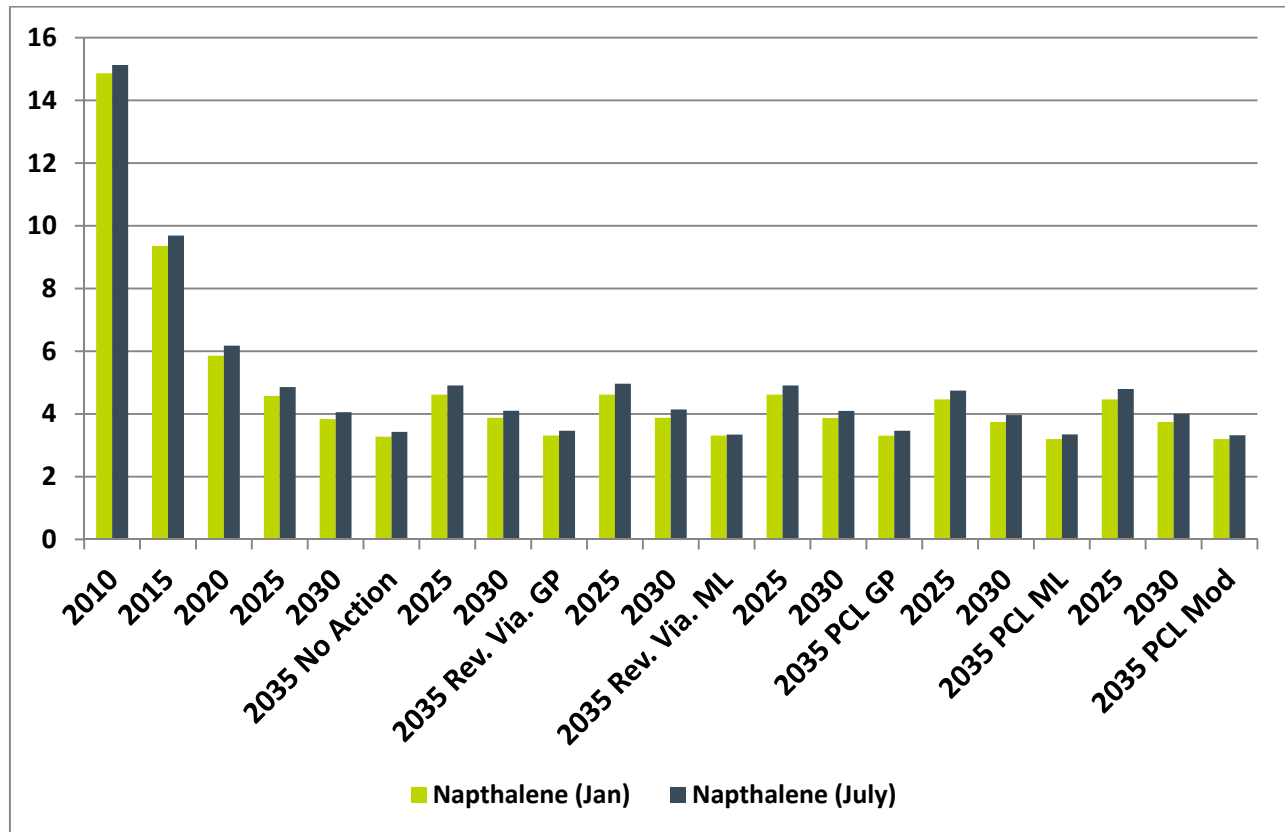
### 7.4.5. Naphthalene

Table 32 and Figure 30 show the naphthalene emission inventories. July emissions are slightly higher than January emissions in all cases because of naphthalene's evaporative properties. In all cases, emissions are showing a downward trend from 2010 through 2035. There are no discernible differences in emissions among alternatives in any given year, so naphthalene is not a discriminating factor in the selection of a preferred alternative.

**Table 32. Naphthalene emission inventories (pounds per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	14.86	14.86	14.86	14.86	14.86	14.86
2015	9.36	9.36	9.36	9.36	9.36	9.36
2020	5.86	5.86	5.86	5.86	5.86	5.86
2025	4.57	4.62	4.62	4.62	4.46	4.46
2030	3.84	3.88	3.88	3.87	3.74	3.74
2035	3.28	3.31	3.31	3.31	3.20	3.20
<b>July</b>						
2010	15.13	15.13	15.13	15.13	15.13	15.13
2015	9.69	9.69	9.69	9.69	9.69	9.69
2020	6.18	6.18	6.18	6.18	6.18	6.18
2025	4.86	4.91	4.96	4.91	4.74	4.80
2030	4.06	4.10	4.14	4.10	3.96	4.01
2035	3.43	3.46	3.34	3.46	3.35	3.32

Figure 30. Naphthalene emission inventories (pounds per day)



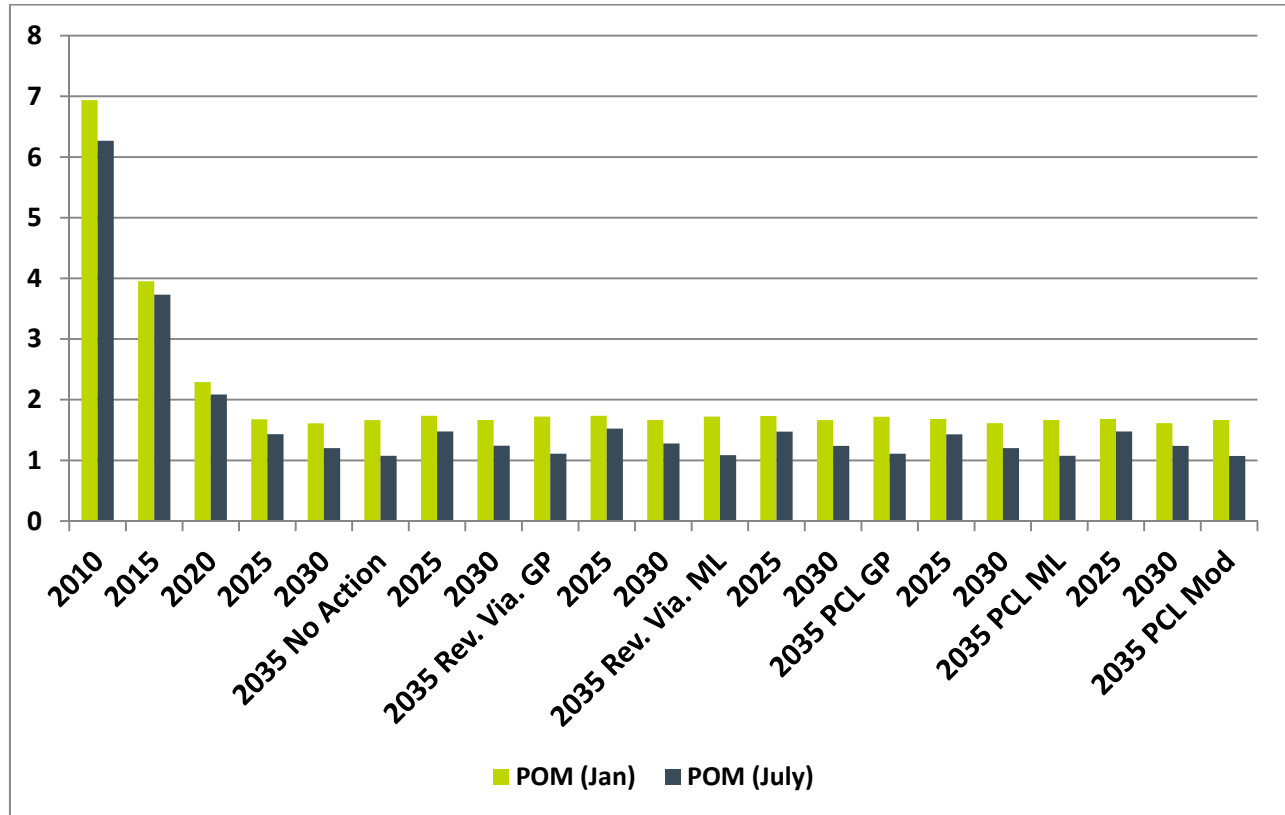
### 7.4.6. Polycyclic organic matter

Table 33 and Figure 31 show the Polycyclic Organic Matter (POM) emission inventories. January emissions are shown to be higher than July emissions in all cases. In all cases, emissions are showing a downward trend from 2010 through 2030, then go back up slightly in 2035. There are no discernible differences in emissions among alternatives in any given year, so POM is not a discriminating factor in the selection of a preferred alternative.

**Table 33. Polycyclic organic matter emission inventories (pounds per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	6.94	6.94	6.94	6.94	6.94	6.94
2015	3.95	3.95	3.95	3.95	3.95	3.95
2020	2.29	2.29	2.29	2.29	2.29	2.29
2025	1.68	1.74	1.74	1.73	1.68	1.68
2030	1.61	1.67	1.67	1.66	1.61	1.61
2035	1.66	1.72	1.72	1.72	1.67	1.67
<b>July</b>						
2010	6.27	6.27	6.27	6.27	6.27	6.27
2015	3.73	3.73	3.73	3.73	3.73	3.73
2020	2.08	2.08	2.08	2.08	2.08	2.08
2025	1.43	1.48	1.52	1.47	1.43	1.48
2030	1.20	1.24	1.28	1.24	1.20	1.24
2035	1.08	1.11	1.09	1.11	1.08	1.07

Figure 31. Polycyclic organic matter emission inventories (pounds per day)



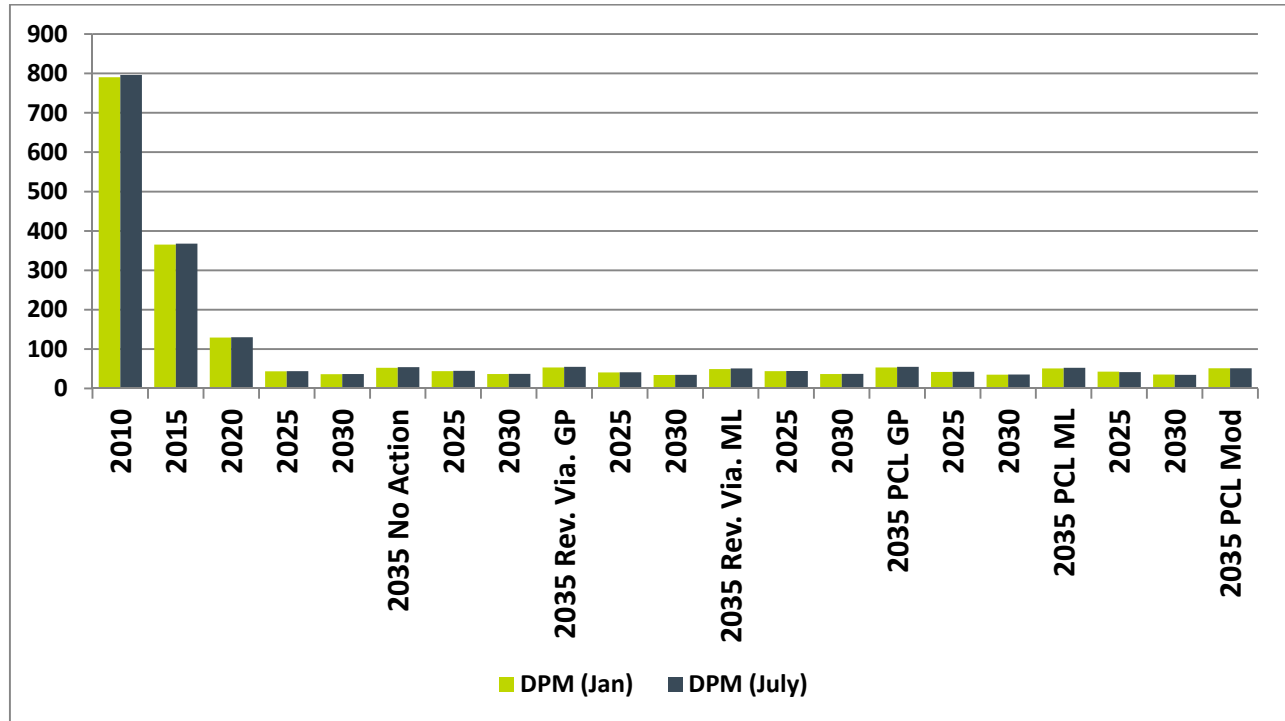
### 7.4.7. Diesel particulate matter

Table 34 and Figure 32 show the diesel particulate matter (DPM) emission inventories. January and July emissions are virtually the same in all cases. The emission trends are downward from 2010 through 2030, then increase slightly in 2035. There are no discernible differences in emissions among alternatives in any given year, so DPM is not a discriminating factor in the selection of a preferred alternative.

**Table 34. Diesel particulate matter emission inventories (pounds per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
<b>January</b>						
2010	790	790	790	790	790	790
2015	366	366	366	366	366	366
2020	130	130	130	130	130	130
2025	44	44	40	44	42	42
2030	36	36	34	36	36	36
2035	52	54	50	54	50	52
<b>July</b>						
2010	796	796	796	796	796	796
2015	368	368	368	368	368	368
2020	130	130	130	130	130	130
2025	44	44	42	44	42	42
2030	36	38	34	38	36	34
2035	54	56	50	54	52	52

Figure 32. Diesel particulate matter emission inventories (pounds per day)



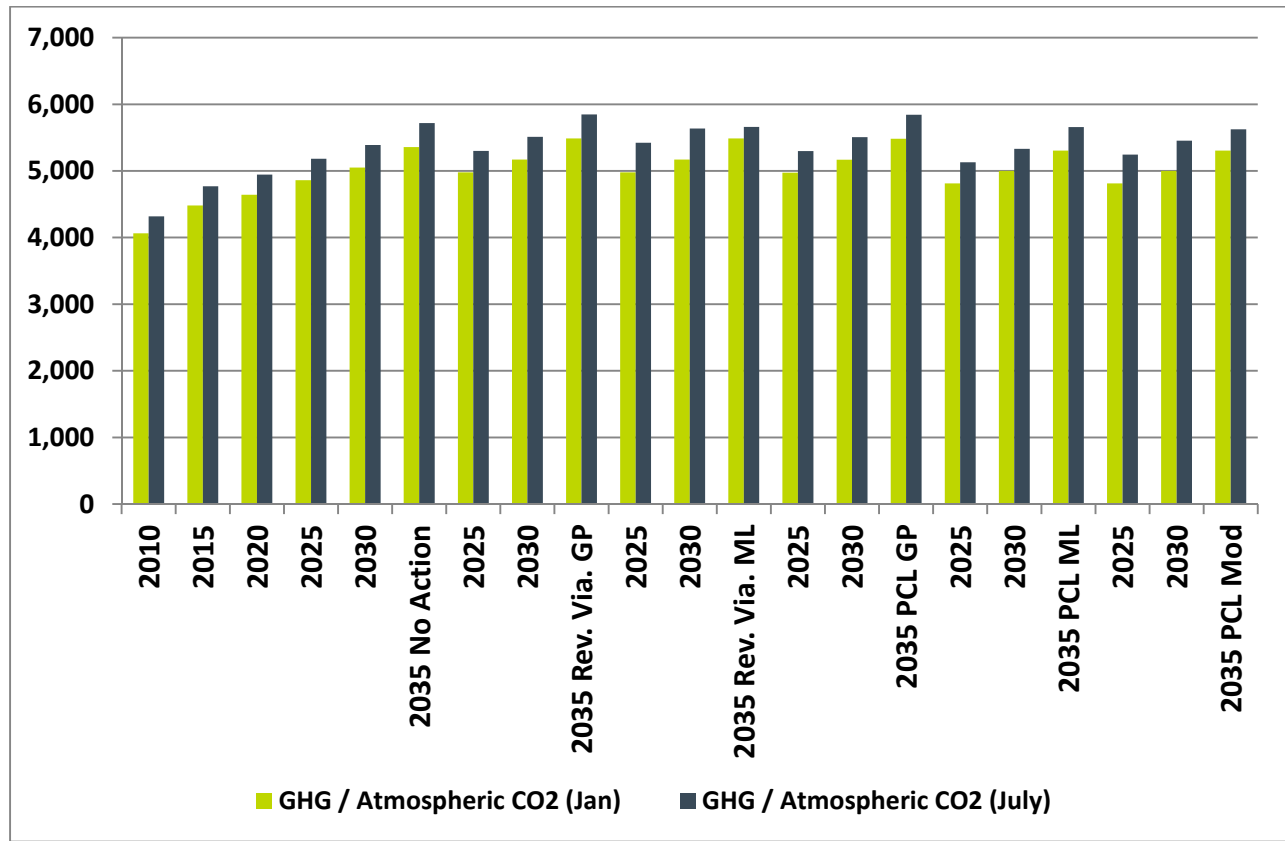
## 7.5. Greenhouse gas emission inventories

The greenhouse gas (i.e., atmospheric CO<sub>2</sub>) emission inventories are shown in Table 35 and Figure 33. Summer (July) emissions are greater than winter (January) in all years and alternatives because of the additional energy consumption related to air conditioning use. The two alternatives with general-purpose lanes that were modeled show almost identical GHG emissions, which would be expected because the freeway capacity is the same for both. The PCL Alternative with Managed Lanes Option results in lower GHG emissions than the modeled Build Alternatives with general-purpose lanes only. The Revised Viaduct Alternative with the Managed Lanes Option, although not modeled, is expected to have GHG emissions similar to the PCL Alternative with the Managed Lanes Option.

**Table 35. Greenhouse gas emission inventory (atmospheric CO<sub>2</sub>, tons per day)**

Year	No-Action	Revised Viaduct—GP	Revised Viaduct—ML	PCL—GP	PCL—ML	PCL—Mod
January						
2010	4,064	4,064	4,064	4,064	4,064	4,064
2015	4,482	4,482	4,482	4,482	4,482	4,482
2020	4,641	4,641	4,641	4,641	4,641	4,641
2025	4,860	4,977	4,977	4,973	4,812	4,812
2030	5,050	5,172	5,172	5,167	5,000	5,000
2035	5,359	5,488	5,488	5,483	5,306	5,306
July						
2010	4,318	4,318	4,318	4,318	4,318	4,318
2015	4,770	4,770	4,770	4,770	4,770	4,770
2020	4,946	4,946	4,946	4,946	4,946	4,946
2025	5,183	5,301	5,422	5,297	5,129	5,246
2030	5,388	5,511	5,636	5,506	5,332	5,453
2035	5,718	5,848	5,660	5,844	5,659	5,625

Figure 33. Greenhouse gas emission inventory (atmospheric CO<sub>2</sub>, tons per day)



## 8. Reduction of air pollutant emissions associated with the project

Motor vehicle emissions from the implementation of the No-Action and Build Alternatives in the study area have been evaluated. With the exception of PM for several of the project alternatives, the project is not expected to cause any new violations of any standard, increase frequency or severity of any existing violation, or delay timely attainment of the NAAQS. The modeled values for the No-Action Alternative and Partial Cover Lowered Alternative, Basic Option with Managed Lanes are below the NAAQS and suggest that there is no exceedance or impact from the project based on the standards. Therefore, for these two alternatives no specific mitigations are necessary for the project to proceed. If an alternative is chosen that requires mitigation, one or more of the potential emission reduction measures described below will be utilized to minimize impacts to air quality. In this case the specific mitigation measures chosen will be detailed in the Final EIS. Additionally, any transportation-related measures or voluntary baseline emission reduction strategies already included as part of CO or PM maintenance plans that relate to I-70 East, such as street sanding/sweeping activities, would need to continue to be implemented with any of the No-Action or Build Alternatives. During construction, dust emissions should be minimized by including techniques to control fugitive dust.

Several ongoing and planned strategies are used in the Denver/North Front Range ozone nonattainment area to reduce precursor emissions of VOC and NO<sub>x</sub> including multi-modal transportation options, rideshare programs, vehicle emissions testing, and intersection improvements. Likewise, several strategies have been, and continue to be, implemented to maintain CO and PM<sub>10</sub> attainment.

The following CO strategies are documented in the *Carbon Monoxide Maintenance Plan for the Denver Metropolitan Area* (APCD, 2005):

- Federal tailpipe standards and regulations, including those for small engines and non-road mobile sources.
- AQCC Regulation No. 4, covering residential wood burning control programs. The Maintenance plan makes no revisions to residential wood burning control programs.
- AQCC Regulations No. 3, No. 6, and Common Provisions, covering industrial source control programs. The Common Provisions, and Parts A and B of Regulation No. 3, are already included in the approved SIP. Regulation No. 6, and Part C of Regulation No. 3, implement the federal standards of performance for new stationary sources and the federal operating permit program. The maintenance plan makes no revisions to these regulations. This reference to Regulation No. 6 and Part C of Regulation No. 3 shall not be construed to mean that these regulations are included in the SIP.
- In accordance with state and federal regulations and policies, the state and federal nonattainment New Source Review requirements in effect for the Denver area reverted to the state and federal attainment Prevention of Significant Deterioration permitting requirements when EPA approved the redesignation request and maintenance plan.

The following PM<sub>10</sub> strategies are documented in the *PM<sub>10</sub> Maintenance Plan for the Denver Metropolitan Area* (APCD, 2005):

- Federal fuels and tailpipe standards and regulations.
- AQCC Regulation No. 4, covering wood stoves, conventional fireplaces, and wood burning restrictions on high pollution days.
- AQCC Regulation No. 16, covering street sanding and sweeping requirements.
- Regulation of stationary sources of emissions via AQCC Regulations Nos. 1, 2, and 6.

## 8.1. Reduction of global greenhouse gas emissions

To help address the global issue of climate change, USDOT is committed to reducing GHG emissions from vehicles traveling on our nation's highways. USDOT and EPA are working together to reduce these emissions by substantially improving vehicle efficiency and shifting toward lower carbon intensive fuels. The agencies have jointly established new, more stringent fuel economy and first ever GHG emissions standards for model year 2012-2025 cars and light trucks, with an ultimate fuel economy standard of 54.5 miles per gallon for cars and light trucks by model year 2025. Further, on September 15, 2011, the agencies jointly published the first ever fuel economy and GHG emissions standards for heavy-duty trucks and buses.<sup>11</sup> Increasing use of technological innovations that can improve fuel economy, such as gasoline- and diesel-electric hybrid vehicles, will improve air quality and reduce CO<sub>2</sub> emissions future years.

Consistent with its view that broad-scale efforts hold the greatest promise for meaningfully addressing the global climate change problem, FHWA is engaged in developing strategies to reduce transportation's contribution to GHGs—particularly CO<sub>2</sub> emissions—and to assess the risks to transportation systems and services from climate change. In an effort to assist States and MPOs in performing GHG analyses, FHWA has developed a *Handbook for Estimating Transportation GHG Emissions for Integration into the Planning Process*. The Handbook presents methodologies reflecting good practices for the evaluation of GHG emissions at the transportation program level, and will demonstrate how such evaluation may be integrated into the transportation planning process. FHWA has also developed a tool for use at the statewide level to model a large number of GHG reduction scenarios and alternatives for use in transportation planning, climate action plans, scenario planning exercises, and in meeting state GHG reduction targets and goals. To assist states and MPOs in assessing climate change vulnerabilities to their transportation networks, FHWA

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<sup>11</sup> For more information on fuel economy proposals and standards, see the National Highway Traffic Safety Administration's Corporate Average Fuel Economy website: <http://www.nhtsa.gov/fuel-economy/>.

has developed a draft vulnerability and risk assessment conceptual model and has piloted it in several locations.

At the state level, there are also several programs underway in Colorado to address transportation GHGs. The Governor's Climate Action Plan, adopted in November 2007, includes measures to adopt vehicle CO<sub>2</sub> emissions standards and to reduce vehicle travel through transit, flex time, telecommuting, ridesharing, and broadband communications. CDOT issued a Policy Directive on Air Quality in May 2009. This Policy Directive was developed with input from a number of agencies, including the State of Colorado's Department of Public Health and Environment, EPA, FHWA, the Federal Transit Administration, the Denver Regional Transportation District and the Denver Regional Air Quality Council. This Policy Directive and implementation document, the CDOT Air Quality Action Plan, address unregulated MSATs and GHGs produced from Colorado's state highways, interstates, and construction activities.

As a part of CDOT's commitment to addressing MSATs and GHGs, some of CDOT's program-wide activities include:

- Developing truck routes/restrictions with the goal of limiting truck traffic in proximity to facilities, including schools, with sensitive receptor populations.
- Continuing to research pavement durability opportunities with the goal of reducing the frequency of resurfacing and/or reconstruction projects.
- Developing air quality educational materials, specific to transportation issues, for citizens, elected officials, and schools.
- Offering outreach to communities to integrate land use and transportation decisions to reduce growth in VMT, such as smart growth techniques, buffer zones, transit-oriented development, walkable communities, access management plans, etc.
- Committing to research additional concrete additives that would reduce the demand for cement.
- Expanding Transportation Demand Management efforts statewide to better utilize the existing transportation mobility network.
- Continuing to diversify the CDOT fleet by retrofitting diesel vehicles, specifying the types of vehicles and equipment contractors may use, purchasing low-emission vehicles, such as hybrids, and purchasing cleaner burning fuels through bidding incentives where feasible. Incentivizing is the likely vehicle for this.
- Funding truck parking electrification (note: mostly via exploring external grant opportunities)
- Researching additional ways to improve freight movement and efficiency statewide.
- Incorporating ultra-low sulfur diesel for non-road equipment statewide.
- Developing a low-VOC emitting tree landscaping specification and emissions absorptive roadside wall landscaping.

Even though project-level mitigation measures will not have a substantial impact on global GHG emissions because of the exceedingly small amount of GHG emissions involved, the following measures during construction will have the effect of reducing GHG emissions. The above-identified activities are part of a program-wide effort by FHWA and CDOT to adopt practical means to avoid and minimize environmental impacts in accordance with 40 CFR 1505.2(c).

## **8.2. Reduction of fugitive particle emissions during construction**

Potential measures for reducing emissions during construction are presented in this section. Construction-related fugitive particle emissions will be minimized by implementing the following dust control practices in accordance with requirements in AQCC Regulation No. 1, Emission Control for Particulate Matter, Smoke, Carbon Monoxide, and Sulfur Oxides:

- Use water or wetting agent in solution to control dust at construction sites.
- Use wind barriers and wind screens to prevent spreading of dust from the site.
- Have a wheel wash station and/or crushed stone apron at egress/ingress areas to prevent dirt being tracked onto public streets.
- Use vacuum-powered street sweepers to remove dirt tracked onto streets.
- Cover all dump trucks leaving sites to prevent dirt and dust from spilling onto streets.
- Cover, wet, compact, or use a chemical stabilization binding agent on all excavated materials.
- Minimize disturbed areas particularly in winter.
- Monitor for PM<sub>10</sub>, which will allow for the real-time modification or implementation of various dust control measures.

Some or all of the measures below may also be implemented, as applicable and manageable, to further reduce construction emissions:

- Prohibit unnecessary idling of construction equipment
- Locate construction diesel engines as far away as possible from residential areas
- Locate staging areas as far away as possible from residential uses
- Require heavy construction equipment to use the cleanest available engines or be retrofitted with diesel particulate control technology
- Use alternatives to diesel engines and/or diesel fuels such as: biodiesel, LNG or CNG, fuel cells, and electric engines
- For wintertime construction, install engine pre-heater devices to eliminate unnecessary idling
- Prohibit tampering with equipment to increase horsepower or to defeat emission control devices effectiveness
- Require construction vehicle engines to be properly tuned and maintained
- Use construction vehicles and equipment with the minimum practical engine size for the intended job

Additionally, for any road construction project, a written control plan must be submitted for approval by CDPHE. The control plan includes all available practical methods that are technologically feasible and economically reasonable to reduce, prevent, and control fugitive particulate emission from the source into the atmosphere. When a plan is approved, CDPHE may take enforcement action if the owner or operator fails to comply with the provisions of a plan.

## 9. References

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#### **From CO report:**

Several regulatory and guidance documents from federal agencies, such as the Environmental Protection Agency (EPA) and FHWA, provide direction for conducting a CO hotspot analysis for conformity and National Environmental Policy Act (NEPA) purposes. In addition, other reference documents are useful in determining input data assumptions. These include:

- FHWA's online *Transportation Conformity Reference Guide* (Revised March 2006; [http://www.fhwa.dot.gov/environment/air\\_quality/conformity/reference/reference\\_guide/](http://www.fhwa.dot.gov/environment/air_quality/conformity/reference/reference_guide/))
- EPA's *Using MOVES in Project-Level Carbon Monoxide Analyses* (EPA-420-B-10-041, December 2010)
- EPA's *Guidance for Modeling Carbon Monoxide from Roadway Intersections* (EPA-454-R-92-005, November 1992, the "1992 Guideline")
- Guideline on Air Quality Models (Appendix W to Part 51, 7-1-11 Edition)
- EPA's *Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a and 2010b* (EPA-420-B-12-028, April 2012)
- EPA's *User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections* (EPA-454/R-92-006R, Revised, September 1995).
- EPA's *Policy Guidance on the Use of MOVES2010 and Subsequent Minor Revisions for State Implementation Plan Development, Transportation Conformity, and Other Purposes* (EPA-420-B-12-010, April 2012)
- CDPHE's *Carbon Monoxide Maintenance Plan for the Denver Metropolitan Area* (December 2005)
- CDOT's *Air Quality Procedures Manual* (2010)
- CDOT's *Air Quality Program Book* (2012)
- CDOT's NEPA Manual (2013, Version 3)
- EPA's Urban Environmental Program in New England, website accessed 08-04-2013; <http://www.epa.gov/region1/eco/uep/sensitivereceptors.html>
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#### **From PM<sub>10</sub> report:**

Several regulatory and guidance documents from federal agencies, such as the Environmental Protection Agency (EPA) and the Federal Highway Administration (FHWA), provide direction for conducting a PM<sub>10</sub> hotspot analysis for conformity and NEPA purposes. In addition, other documents are used in determining input data assumptions. These include:

- Transportation Conformity Regulations (40 CFR §51.390 and §93), as amended

- EPA's *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM<sub>2.5</sub> and PM<sub>10</sub> Nonattainment and Maintenance Areas* (EPA-420-B-13-053, November 2013)
- EPA's *Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a and 2010b* (EPA-420-B-12-028, April 2012)
- EPA's *Policy Guidance on the Use of MOVES2010 and Subsequent Minor Revisions for State Implementation Plan Development, Transportation Conformity, and Other Purposes* (EPA-420-B-12-010, April 2012)
- CDPHE's *Colorado State Implementation Plan for PM<sub>10</sub>, Revised Technical Support Document* (September 2005)
- EPA, 2013 Urban Environmental Program in New England; website accessed 08-04-2013; <http://www.epa.gov/region1/eco/uep/sensitivereceptors.html>
- California Environmental Protection Agency, 2005, *California Air Resources Board Air Quality and Land Use Handbook: A Community Health Perspective*. Website accessed 08-04-2013 <http://www.arb.ca.gov/ch/landuse.htm>

**From Criteria Pollutants/MSAT/GHG report:**

Several regulatory and guidance documents from federal agencies, such as the Environmental Protection Agency (EPA) and the Federal Highway Administration (FHWA), provide direction for conducting criteria pollutant, MSAT, and GHG analysis for NEPA purposes. In addition, other documents are used in determining input data assumptions. These include:

- Transportation Conformity Regulations (40 CFR §51.390 and §93), as amended
- EPA's *Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a and 2010b* (EPA-420-B-12-028, April 2012)
- *Using the MOVES and EMFAC Emissions Models in NEPA Evaluations*, letter from Susan E. Bromm, Director, EPA's Office of Federal Activities, to NEPA/309 Division Directors dated February 8, 2011
- FHWA's *Interim Guidance Update on Mobile Source Air Toxics Analysis in NEPA*, memorandum from April Marchese, Director, Office of Natural Environment, to Division Administrators dated December 6, 2012
- EPA's *Using MOVES for Estimating State and Local Inventories of On-Road Greenhouse Gas Emissions and Energy Consumption* (EPA-420-D-12-001, Public Draft, January 2012)

# **Attachment J – Appendix A**

## **Air Quality Protocol**





# **I-70 East Corridor Draft Environmental Impact Statement**

## **Draft Air Quality Analysis Protocol**

Revised November 18, 2013



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# 1. Introduction

This document describes the proposed air quality analysis approach for the I-70 East project. The approach outlined in this document goes beyond federal requirements in several areas because of air quality concerns expressed during the public involvement process. This protocol is specific to this project only—it does not represent a change to Colorado Department of Transportation (CDOT)/Federal Highway Administration (FHWA) standard practice for analysis of air quality impacts in the National Environmental Policy Act (NEPA) process, nor does it establish a precedent for future air quality analyses in Colorado.

# 2. Background

The Draft Environmental Impact Statement (EIS) for the I-70 East project was released to the public in November 2008. No public support was received on any of the proposed alternatives in the 2008 Draft EIS; therefore, CDOT and FHWA committed to selecting a preferred alternative by using a collaborative decision-making process in partnership with corridor communities and stakeholders. As a result, CDOT formed the Preferred Alternative Collaborative Team (PACT) to arrive at a preferred alternative, but this process ended without consensus in August 2011.

Since then, CDOT has identified a new alternative, the Partial Covered Lowered Alternative, which retains I-70 on its current alignment, but lowers the highway between Brighton Boulevard and Colorado Boulevard (similar to portions of I-25 south of Broadway) with a 900-foot-long cover over the highway between Columbine Street and Clayton Street near Swansea Elementary School. This new alternative as well as any changes to previously analyzed alternatives required the development of the Supplemental Draft EIS, scheduled to be released for public review in summer 2013.

Traffic data from the DRCOG model is being used to conduct the air quality analysis for the Supplemental Draft EIS. The air quality analysis will be updated with DynusT model results prior to the Final EIS. The interim DRCOG model data will come from the Compass and not the newer Focus regional travel demand model. The Compass model is still the official model for use on project-level studies in the region. FTA has not approved the Focus model yet (for New Starts projects) and no consultants are able to run the Focus model at this time. However, the traffic modeling for the project will use the updated socioeconomic forecasts produced by DRCOG in the fall of 2012.

This document details each of the proposed approach elements, with project-level conformity addressed first, followed by elements of the NEPA analysis. The U.S. Environmental Protection Agency's (EPA) transportation conformity hotspot guidance documents<sup>1</sup> for carbon monoxide (CO) and particulate matter less than 10 micron size (PM<sub>10</sub>) identify many items for interagency consultation, which are reflected in the following sections. For those items where the guidance provides some flexibility and defers to the interagency consultation process, the project team has proposed options and/or a preferred approach.

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<sup>1</sup> Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM<sub>2.5</sub> and PM<sub>10</sub> Nonattainment and Maintenance Areas (EPA-420-B-10-040, December 2010)

Using MOVES in Project-Level Carbon Monoxide Analyses. (EPA-420-B-10-041, December 2010)

Official Release of the MOVES2010a and EMFAC2007 Motor Vehicle Emissions Models for Transportation Conformity Hot-Spot Analyses and Availability of Modeling Guidance (Federal Register, Volume 75, No. 243, December 10, 2010)

## 3. Transportation Conformity

The Supplemental Draft EIS will include a discussion and preliminary analysis of transportation conformity. A formal draft project-level conformity determination will be included in the Final EIS, with the final conformity determination made in the Record of Decision.

Project-level conformity applies to transportation projects in air quality nonattainment and attainment/maintenance areas. Project-level conformity is conducted for projects that are funded and/or approved by FHWA or FTA and/or considered regionally significant. To pass project-level conformity, the project must be included in a conforming RTP and TIP; and the project cannot create new, increase the frequency of, or exacerbate the severity of air quality violations. Furthermore, the design and concept for the proposed project must be adequately defined and must remain consistent with the project's definition in the conforming RTP and TIP.

If the project changes in concept or design during the planning process, or if it was not originally included in the RTP and TIP, the regional conformity analysis would need to be revisited before the project can proceed. This is the case with the I-70 East Corridor. There are some projects included in the 2035 RTP which is developed and maintained by DRCOG. However, neither the No-Build nor any of the alternatives are fully included in the RTP. An amendment to the RTP will be necessary once the preferred alternative is selected and prior to the issue of a Record of Decision by FHWA.

The following projects related to the I-70 East Corridor are included in the 2035 RTP:

- I-70 viaduct replacement (partial) from Brighton Boulevard to Colorado Boulevard
- I-70 widening from I-270 to Havana Street
- I-70 at Vasquez Boulevard interchange improvements

### 3.1. Carbon Monoxide

The 2008 Draft EIS included CO hotspot modeling for four intersections. The project team proposes to scale back the CO hotspot analysis for the Supplemental Draft EIS. The team feels that this is justified because the CO modeling for the 2008 Draft EIS showed reasonably low values (approximately 5 to 6 parts per million [ppm] compared to a standard of 9 ppm) and MOVES CO emissions rates are lower than the MOBILE6.2 rates used in the 2008 Draft EIS.

The 2008 Draft EIS found that the interchange at I-70 and Colorado Boulevard would have the highest CO concentrations in the project area. Because the alternatives evaluated in the Supplemental Draft EIS are expected to have similar impacts on speeds and traffic volumes to those in the 2008 Draft EIS, the project team proposes to consider this location to represent the worst case within the project area and to model only this location for CO. Due to more detailed DynusT mesoscopic simulation model now being applied in this analysis, however, there is a possibility that the worst-case location could change. This will be monitored and a different location may be modeled if warranted.

CDOT will conduct the CO hotspot analysis using CAL3QHC and MOVES. Concentration estimates will be produced for all alternatives and options. Background concentrations will be calculated using the procedure in 40 Code of Federal Regulations (CFR) §93.123(c) (transportation conformity rule) in consultation with the Air Pollution Control Division (APCD). The conformity rule requires the analysis to cover the year of peak emissions. In the 2008 Draft EIS, the year of peak emissions was 2030; however, the Draft EIS also indicated that concentrations would be highest in 2010. CDOT will address this uncertainty by comparing emissions factors and VMT for interim years 2015, 2020, 2025 and 2030 to see if they “peak” prior to the design year. The consideration of multiple years is appropriate given the project phasing.

CDOT will then model a worst-case emissions scenario using the highest peak period traffic volumes and lowest peak period temperatures and speeds. The conformity rule requires modeling of locations that are or will be at level of service D or worse. In the case of the I-70 project, this could be dozens of intersections. Because the project team is proposing to model only the worst-case location, the EPA Regional Administrator will need to approve this approach pursuant to 40 CFR §93.123(a)(1). Similar approval was sought and received for the streamlined approach used for CO hotspot modeling for the T-Rex project.

The following comments were received from EPA Region 8 on March 5, 2013:

*Region 8 consulted with our Office of Transportation and Air Quality (OTAQ) and we have agreed that this approach is acceptable, as was done for the Trex project, for CO hotspot modeling for the I-70 East project.*

A letter was received from Shaun L. McGrath, EPA Region 8 Administrator, on June 12, 2013, formally agreeing to the above methodology.

### 3.2. Particulate Matter (PM<sub>10</sub>)

While the community and the reviewing agencies are concerned about the potential particulate matter impacts from the project, the regulatory definition of a “project of air quality concern” in 40 CFR §93.123(b) centers on whether the project has a significant impact on diesel traffic volumes. Because the project does not include transit-related elements and Denver is a PM<sub>10</sub> maintenance area (e.g., the State Implementation Plan [SIP] does not identify “areas of violation or possible violation”), the following criteria from this section of the rule apply:

- b. PM<sub>10</sub> and PM<sub>2.5</sub> hot-spot analyses.
  - i. The hot-spot demonstration required by §93.116 must be based on quantitative analysis methods for the following types of projects:
    - (1) New highway projects that have a significant number of diesel vehicles and expanded highway projects that have a significant increase in the number of diesel vehicles;
    - (2) Projects affecting intersections that are at Level-of-Service D, E, or F with a significant number of diesel vehicles or those that will change to Level-of-Service D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project.

The project team believes that it can demonstrate that the project is not a “project of air quality concern” pursuant to the conformity rule because there is no *significant* change in diesel truck traffic between the No-Action Alternative and any of the Action alternatives. The 2008 Draft EIS found very small changes in truck traffic under the alternatives, largely because there are no existing alternative routes for traffic to divert from and the same is expected from the updates with the Supplemental Draft EIS.

The model results for the No-Action and two build alternatives indicate that the I-70 East Corridor is not a project of air quality concern. Table 1 shows the commercial vehicle miles of travel (VMT) and vehicle hours of travel (VHT) for the three Compass model runs based on the project study area for air quality. The study area is based on the impacts of different I-70 alternatives on the surrounding roadway network.

The results in Table 1 indicate a very small increase (i.e., 1–3%) in commercial vehicle VMT in the study area between the No-Action and build alternatives. Congested VHT decreases between the No-Action and build alternatives. In some respects, VHT is the better measure because emissions are a function of speed. In either case, a small increase in VMT and a small decrease in VHT confirm that the I-70 East Corridor is not a project of air quality concern with regard to the PM<sub>10</sub> analysis and transportation conformity requirements.

**Table 1. Commercial Vehicle Miles and Hours of Travel (2035, study area)**

Measure	No-Action	Revised Viaduct – General Purpose	Partial Cover Lowered - General Purpose	Partial Cover Lowered – Managed Lanes
<b>Vehicle Miles of Travel (VMT)</b>	<b>503,400</b>	<b>521,500</b>	<b>519,900</b>	<b>506,700</b>
	Percent Difference from No-Action	<b>4%</b>	<b>3%</b>	<b>1%</b>
<b>Vehicle Hours of Travel (VHT)</b>	<b>16,660</b>	<b>16,280</b>	<b>16,290</b>	<b>16,220</b>
	Percent Difference from No-Action	<b>-2%</b>	<b>-2%</b>	<b>-3%</b>

Based on this information, it does not appear that a PM10 hotspot analysis will be required for conformity. Once the more detailed Dynus-T travel modeling results are available, the project team will reevaluate this conclusion and engage the Interagency Consultation group. The group will either confirm that the project is not a “project of air quality concern” for conformity purposes or discuss any necessary changes to the PM10 hotspot modeling analysis being conducted for NEPA purposes (discussed below) in order for it to also meet applicable conformity requirements.

## 4. NEPA Analysis

### 4.1. National Ambient Air Quality Standards and Mobile Source Air Toxics Emissions Analysis

As with the 2008 Draft EIS, the Supplemental Draft EIS will include an emissions inventory for National Ambient Air Quality Standards (NAAQS) pollutants/precursors and Mobile Source Air Toxics (MSAT) pollutants that will be developed using MOVES2010b’s County Scale option. The MSATs analyzed will reflect the more recent list of priority MSATs in FHWA’s 2009 guidance. The analysis will be conducted by APCD using traffic data provided by CDOT.

Emission factors are generated at the County-Scale in MOVES and applied at the link level. In MOVES, the County Scale is one of three options for running the model. It facilitates the use of local input data to develop emissions factors. It does not mean that county-level emissions totals will be generated.

The 2008 Draft EIS included several analysis years (1990, 2001, 2010, 2020, and 2030) based on input received during the consultation process for the document. This analysis was compromised by the fact that the 1990 vehicle miles of travel (VMT) came from a different source and estimates for the more recent years were suspect (while VMT grew by 20-30 percent each decade between 2001 and 2030, it appeared to “grow” by almost 100 percent between 1990 and 2001).

For the supplemental DEIS, the problematic 1990 and 2001 analysis years will no longer be included so that the analysis for different years is based on the same source for travel data. The revised analysis will use a base year of 2010 and a horizon year of 2035 consistent with other major projects.

## 4.2. PM<sub>10</sub> Quantitative Hotspot Analysis

### General modeling approach

Quantitative PM<sub>10</sub> hotspot analysis will be conducted for NEPA purposes to address community/reviewing agency concerns about PM<sub>10</sub> concentrations. CDOT plans to perform this analysis in-house using alternative-specific traffic data provided by the consultant team. CDOT proposes to use MOVES2010b at the Project scale for emissions analysis along with road dust/sanding emissions factors from the current PM<sub>10</sub> maintenance plan and the AERMOD dispersion model. AERMOD was selected because 1) CDOT staff have considerable experience with running AERMOD, 2) AERMOD can model closure of the truck stop affected by some of the alternatives, and 3) AERMOD can model the outflow from the proposed decked portion of I-70.

### Season(s) to be modeled

Because PM<sub>10</sub> (and CO) violations have typically occurred in the winter and the maintenance plans for these pollutants address wintertime conditions, the project team proposes modeling only the winter season. This will reduce the MOVES modeling workload by a factor of four while still modeling the “worst-case” season for air quality in Denver.

### Location(s) to be modeled

Because this project covers a large geographic area, the project team prefers to model a subset of the project with the highest likelihood of PM<sub>10</sub> NAAQS violations. The highest volume locations in the project area are associated with major interchanges. The 2008 Draft EIS provided estimated traffic volumes for 2030, as listed in Table 2.

**Table 2. 2030 Estimated Traffic Volumes**

Interchange	2030 Annual Average Daily Traffic
I-70/I-25	~400,000
I-70/I-270	~370,000
I-70/I-225	~350,000
I-70/Peña Boulevard	~305,000

The I-70/I-25 interchange is outside of the project limits but upwind of the project area under some met conditions. Volumes at this interchange change slightly under some alternatives. The I-70/I-270 and I-70/Peña Boulevard interchanges have high traffic volumes but no nearby land uses with public access. Background concentrations are likely to be the same at all locations based on the proximity of the nearby PM<sub>10</sub> monitors (the same background concentrations would likely be used for any locations along the corridor, as discussed in the following subsection). Considering these factors, the project team proposes two modeling locations: (1) from the Mousetrap east along I-70 to the Vasquez Boulevard/Steele Street interchange and (2) the area around the I-70/I-225 interchange.

There are several build alternatives associated with the project, and some of these alternatives include “options” (e.g., managed lanes or no managed lanes). The project team will produce concentration estimates for each alternative and option (including No-Action).

## Emissions modeling

Hotspot analysis for transportation conformity is required to address the “years of peak emissions.” While this analysis is being conducted for NEPA purposes and not conformity, CDOT proposes to apply the same guideline. For PM<sub>10</sub>, the project team proposes to model the design year (2035) based on the growth in PM<sub>10</sub> emissions documented in the 2008 Draft EIS. (CDOT will verify that the emissions trend using MOVES is the same as the trend calculated for the prior DEIS with MOBILE6.2.) Prior to conducting modeling, the project team will evaluate emissions in multiple years due to project phasing—that is, compare emissions factors and VMT for interim years to see if they “peak” prior to the design year (such that lower VMT in an interim year could still result in higher emissions). If this turns out to be the case, then the project team will model whichever year results in the highest emissions.

The project team will need to define which roadway links to model for each location. Based on the examples in EPA’s particulate matter hotspot training materials, the team proposes to model freeway links, major arterial links, and associated connecting roads (ramps and frontage roads) that are affected by the project.

Also, based on EPA’s guidance, the project team proposes to model daily emissions using four MOVES runs reflecting morning (AM) peak, midday, evening (PM) peak, and overnight. At this point, it appears that traffic data from the DynusT model will be available for AM peak, PM peak, and daily, so the midday and overnight travel activity will need to be estimated using data for the three available time periods and the DRCOG model results.

A major truck stop servicing the corridor will be closed under some of the alternatives. It will be modeled as an off-network link in MOVES and modeled as an explicit source in AERMOD. Activity data for the truck stop will be obtained from data collected by the project team either through peak hour counts or supplied by the business proprietor.

Construction dust will not be included in the analysis because construction is not expected to last longer than 5 years at any individual site.

The following additional MOVES input assumptions will be used:

- **Link source type (vehicle mix).** To meet schedule demands, initial link data will be constructed from the Denver Regional Council of Governments (DRCOG) conformity model. Additional, higher-accuracy traffic data from the DynusT model will be available later and incorporated into the analysis prior to the Final EIS. CDOT will compare datasets and update links to reflect the DynusT model results where a statistically significant difference is demonstrated.
- **Non-travel-related inputs.** CDOT is working with APCD to assemble non-travel-related inputs such as age distribution, fuels, Inspection/Maintenance (I/M), and meteorological inputs. Under EPA’s particulate matter hotspot guidance, the meteorological inputs for the MOVES modeling need to be consistent with the AERMOD met inputs and the inputs used for the regional emissions analysis for conformity. CDOT will develop temperature and humidity data for the four MOVES time periods by extracting and averaging the relevant hourly data from the AERMOD meteorological data set.

## Dispersion modeling

AERMOD receptors will be located per the general guidelines for PM<sub>10</sub> in EPA’s particulate matter hotspot guidance. AERMOD will be used to auto-generate receptors for the PM hotspot analysis and any receptors that are in the right-of-way or on property where the general public does not have access will be removed.

Identifying an appropriate monitor to use for PM<sub>10</sub> background concentrations is a key topic for interagency consultation. A complicating factor is that there is no monitor that is upwind from the project area under most meteorological conditions that also captures the industrial contributions that the project area neighborhoods are concerned about. Denver’s Continuous Ambient Monitoring Program (CAMP) station and the Commerce City, Welby, and National Jewish Health (NJH) sites are the closest monitors to the project area. CAMP is in

the Central Business District and is not representative of land use anywhere else in the project corridor. It appears that the NJH monitor does not record PM<sub>10</sub> emissions. Each of the monitors is downwind of at least one major highway, which means they may not represent a true background value. After reviewing the locations of these three monitors on aerial photographs, the project team proposes to use Commerce City as the background monitor as it best captures the industrial PM<sub>10</sub> contributions in the project area and is a reasonable distance from the I-70 corridor (i.e., it may best reflect actual background concentrations, excluding I-70 impacts). It also may be appropriate to use a different monitor or interpolate between these and/or another monitor.

The following comments were received from EPA Region 8 on March 5, 2013:

*EPA would note that interpolating between monitors would require additional guidance from OTAQ and our Office of Air Quality Planning and Standards (OAQPS) and may require significant effort. Perhaps the best course would be, as noted above, to try to select a single monitor that would sufficiently represent the background concentrations for the project.*

EPA's guidance requires use of the highest PM<sub>10</sub> value over a 3-year period, excluding exceptional events, to represent background. The project team proposes to determine the background concentration using 2009-2011 data because calendar year 2012 data will not be complete and quality assured until the PM<sub>10</sub> hotspot analysis is already complete. (According to EPA's AirData site, annual statistics for 2012 are not final until May 1, 2013.) The 2012 data can be reflected in revised design value calculations for the Final EIS.

### 4.3. CO Hotspot modeling

The CO hotspot analysis for conformity purposes will also serve as the analysis for NEPA. While the conformity regulations only require analysis of a preferred alternative (and the No-Action Alternative if the preferred alternative violates the NAAQS), the CO hotspot analysis will include all of the alternatives for NEPA purposes.

### 4.4. Evaluating CO Concentrations in the Covered Portion of I-70

An emergency ventilation system is assumed as part of the Partial Cover Lowered alternatives. The ventilation system is for emergency situations including incidents, accidents, and weather. It would operate automatically based on emissions sensors in the tunnel.

The project team wishes to evaluate the CO levels that motorists and/or workers may be exposed to with its natural ventilation design, particularly under conditions of slowed or stopped traffic due to snowstorms or traffic incidents. FHWA guidance establishes maximum CO levels in tunnels to protect the travelling public with an adequate margin of safety (see Table 3).

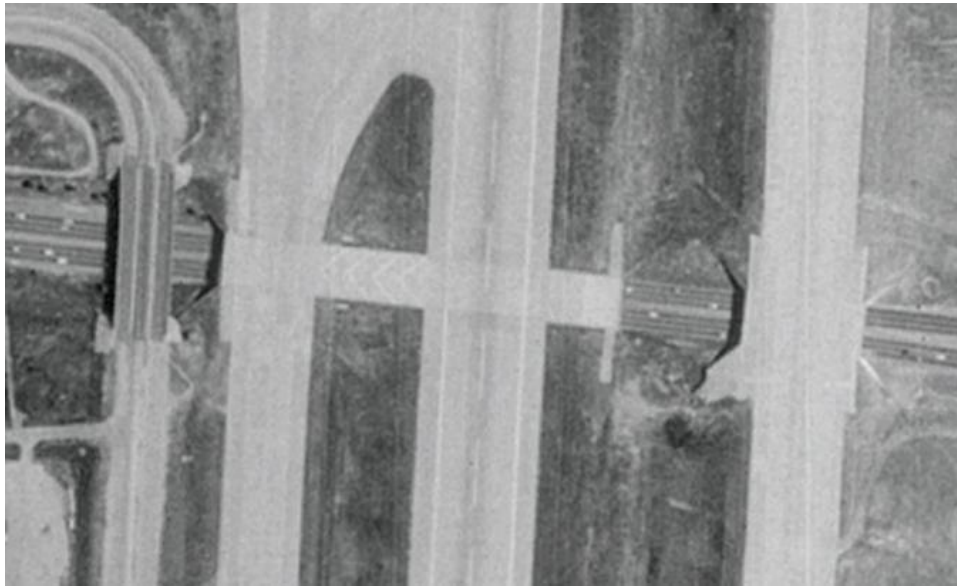
**Table 3. Maximum Carbon Monoxide Levels in Tunnels**

Maximum CO Level (ppm)	Peak-hour Exposure Time (minutes)
120	15
65	30
45	45
35	60

Source: Revised Guidelines for the Control of Carbon Monoxide Levels in Tunnels (FHWA-HEV-30, March 31, 1989)

The projected levels of CO will be analyzed using guidance from Chapter 13, Enclosed Vehicular Facilities from *The American Society of Heating, Refrigerating and Air-Conditioning Engineers Applications Handbook* (2011, pages 13.1-13.30). The covered portion of I-70 matches the American Society of Heating, Refrigerating, and Air-Conditioning Engineers guidance's characterization of a bi-directional tunnel with natural or traffic-induced ventilation and these data points will be applied for the air quality analysis.

As a side note, two Stapleton Airport Tunnels carried I-70 under one of the airport's north-south runways and taxiways from the 1970's to 1995. The east tunnel was the shorter of the two and was built later than the longer tunnel. The longer tunnel is estimated to be approximately 800 feet in length based on relationships using old aerial photography. The length of the shorter tunnel is estimated at 250 feet with a 250 foot separation between the tunnels.



*Aerial photo of Stapleton Airport Tunnels*  
Scale: 1 inch = 400 feet (approx.)

## **4.5. Mobile Source Air Toxics**

FHWA recently revised the guidance for MSAT analyses in NEPA documentation. The revisions reflect recent MSAT research and changes in methodology for conducting emissions analysis. They incorporate the use of the latest version of MOVES (MOVES2010b) in MSAT analyses for NEPA studies. To the extent possible, the Supplemental Draft EIS will address the recommendations of the guidance, but revisions may be needed for the Final EIS.

As noted earlier, an MSAT emissions burden analysis similar to the analysis in the 2008 Draft EIS will be compiled by APCD using MOVES with CDOT providing traffic data. The MSAT analysis will cover the newer list of seven priority MSATs in FHWA's 2009 guidance.

The project team will obtain and summarize MSAT monitoring data for the project area and, to the extent possible, report trends. New data will not be collected. FHWA will work with CDOT to develop updated language describing MSAT research conducted since the 2008 Draft EIS. This will be based on FHWA's updated MSAT guidance.

The Supplemental Draft EIS will include an expanded discussion of the findings of the Good Neighbor study in consultation with City and County of Denver Department of Environmental Health (DEH). DEH has committed to updating the Good Neighbor study to reflect updated emissions factors in MOVES. CDOT intends to provide DEH with recalculated MOVES emissions factors for the Good Neighbor project area that will replace those originally generated by MOBILE6.2, which is no longer supported by EPA.

DEH will use these emissions factors in conjunction with their existing CALPUFF modeling platform to analyze trends in air quality. CALPUFF is being used rather than AERMOD for the MSAT analysis because AERMOD is not supported for near-roadway applications of MSATs. This will help the public see how emissions might change compared to the levels DEH modeled for their 2007 report (due to fleet turnover and use of MOVES). The full study will be posted on the I-70 East project website, along with CDOT addendums containing emissions comparisons and analysis of trends in air quality, if possible.

The following comments were received from EPA Region 8 on March 5, 2013:

*Region 8 has conferred with OTAQ and we note that this statement (i.e., CALPUFF is being used rather than AERMOD for the MSAT analysis because AERMOD is not supported for near-roadway applications of MSATs) is not correct and does not comport with general practice among air quality modelers. AERMOD, CALINE3, CAL3QHC, and CAL3QCHR are all able to model MSAT concentrations. The modeling procedures outlined in the EPA guidance document, Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM<sub>2.5</sub> and PM<sub>10</sub> Nonattainment and Maintenance Areas, are applicable to MSATs, as specified in Section 1.5 of that document. We note also that AERMOD is able to model NO<sub>2</sub> concentrations, as specified in Section 10 of EPA's Near-road NO<sub>2</sub> Monitoring Technical Assistance Document. In conclusion, there is no technical reason why AERMOD could not be used to model MSATs or NO<sub>2</sub> or why CALINE3, CAL3QHC, or CAL3QHCR could not be used to model MSATs.*

EPA has determined that the PM<sub>2.5</sub> NAAQS are also protective of exposure to diesel particulate matter. The Supplemental Draft EIS could cite this information and show the trend in PM<sub>2.5</sub> concentrations as a way of addressing this particular MSAT.

## **4.6. Greenhouse Gases**

An updated version of the FHWA standard language will be used with modifications by CDOT to reflect Colorado climate activities. The table at the end will be replaced with greenhouse gas emissions by alternative calculated by APCD using the same travel data as the MSAT analysis. The MOVES emission factors for GHGs including CO<sub>2</sub> will include adjustments for the most recent changes to the CAFE fuel economy standards. Global, national, statewide, and regional GHG emissions from the FHWA table and other sources as available will be included in the supplement to the DEIS to provide context.

## **4.7. Construction Fugitive Dust**

The 2008 Draft EIS included a short discussion of construction fugitive dust impacts and a comparison of the volume of material moved for each construction alternative. The project team proposes that this analysis should be updated in the Supplemental Draft EIS. This is included for NEPA purposes, not conformity. As noted previously, construction is not expected to last long enough for these emissions to be included in a conformity analysis. Monitoring plans have not yet been prepared, but monitoring of PM<sub>10</sub> emissions during construction is anticipated.



**Attachment J – Appendix B**  
**EPA Letter Approving an Alternative**  
**Methodology for CO Hotspot Analysis**





**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION 8**

1595 Wynkoop Street  
DENVER, CO 80202-1129  
Phone 800-227-8917  
<http://www.epa.gov/region08>

**JUN 12 2013**

Ref: 8P-AR

Jane Hann  
Branch Manager  
Environmental Programs Branch  
Colorado Department of Transportation  
4201 East Arkansas Avenue  
Denver, Colorado 80222

Dear Ms. Hann:

Thank you for your letter of May 2, 2013 (copy enclosed) which requested EPA's concurrence, in consideration of 40 CFR 93.123, regarding the proposed carbon monoxide (CO) air quality analysis modeling methodology for the I-70 East project. This letter provides our response.

The proposed I-70 East project's modeling methodology recommends a streamlined analysis for a single representative intersection (I-70 at Colorado Boulevard) reflecting a worst-case hotspot analysis for CO for the future year of 2035. This methodology is proposed for use in the new Supplemental Draft EIS for the I-70 East project. We note and support that the modeling proposal will update the CO conformity results from the five CO hotspot analyses that were provided in the 2008 I-70 East Draft EIS (DEIS) which were all shown to be below the CO National Ambient Air Quality Standard (NAAQS). In addition, your letter states that the CO hotspot modeling for the Supplemental DEIS will include updated traffic data, use the latest Denver Regional Council of Governments (DRCOG) transportation planning assumptions, revise the project's modeling horizon year from 2030 to 2035, and use EPA's MOVES model for the emissions calculations.

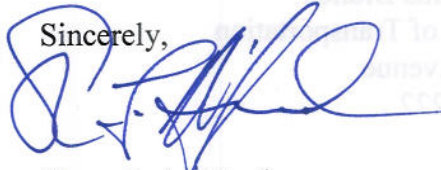
The EPA appreciates that the Final EIS will consider all revised traffic information and those data will be used to compare projected operational conditions to verify that the Colorado Boulevard interchange is indeed the appropriate worst-case CO location along the I-70 East project's corridor. We note that your letter commits to re-evaluating the traffic modeling results and if that evaluation indicates that a different location should be modeled for a CO worst-case hotspot, then modification will be vetted through the interagency consultation procedure and they will then be included in the Final EIS documentation.

Finally, your letter states that if the worst-case hotspot intersection (I-70 at Colorado Boulevard) modeling predicts CO concentrations below the 8-hour CO NAAQS, then it can be assumed that intersections along the I-70 East project corridor with lower traffic volume and better operating parameters would also have a value below the CO 8-hour NAAQS. The EPA concurs with this premise. We appreciate CDOT's commitment to prepare a conventional CO hot spot analysis for 2020 and 2035 if the modeling results for the worst-case hotspot intersection are equal to or above the CO 8- hour NAAQS.

The EPA evaluated the information provided in your May 2, 2013 letter and considered the CO hotspot modeling information from the prior 2008 I-70 East project DEIS. We concur that the CDOT's proposed CO hotspot modeling methodology air quality analysis for the I-70 East Supplemental Draft EIS project meets the requirements of 40 CFR 93.123. We also note that this methodology will satisfy the requirements for a CO hotspot analysis for air quality impacts under the National Environmental Policy Act. Please note though, this letter does not serve as a blanket approval of this CO hotspot modeling methodology for any other project.

Thank you for providing the EPA with an opportunity to review the proposed analytical approach for air quality before initiating the analysis. Should there be any questions, please contact Carl Daly, Director, Air Program at (303) 312-6416 or your staff may also wish to contact Tim Russ, Air Program staff, at (303) 312-6479.

Sincerely,



Shaun L. McGrath  
Regional Administrator

Enclosure

Cc: Stephanie Gibson, FHWA  
William Haas, FHWA  
Jim Dileo, CDPHE, APCD



# STATE OF COLORADO

DEPARTMENT OF TRANSPORTATION  
Environmental Programs Branch  
4201 East Arkansas Avenue  
Denver, Colorado 80222  
(303) 757-9011



May 2, 2013

James B. Martin  
Regional Administrator  
US Environmental Protection Agency  
Region 8  
1595 Wynkoop Street  
Denver, CO 80202-1129

Dear Mr. Martin,

FHWA and CDOT respectfully request the EPA approval of the carbon monoxide (CO) hot spot analytical methodology for the I-70 East **Supplemental Draft** Environmental Impact Statement (EIS). The proposed project's methodology recommends streamlining analysis to a single representative intersection reflecting a worst-case hot spot analysis for the future year 2035. This proposal is provided to update the CO conformity results from the five hot spot analyses already completed in the 2005 I-70 East Draft EIS which all were shown to be below the National Ambient Air Quality Standard (NAAQS) at that time. This methodology will utilize 2010 emissions rates with the new 2035 traffic projections at the worst operating, highest volume intersection in the project area.

## Conformity Background

The I-70 East project area is a part of the Central Front Range Air Quality Control Region. Portions of I-70 East project alternatives are included, as placeholders, in the Denver Regional Council of Governments (DRCOG) 2035 Regional Transportation Plan (2011) and have been included in the air quality modeling for the latest conformity determination of the Regional Transportation Plan. However, the I-70 East project does not meet the regional conformity requirements of the Clean Air Act because a preferred alternative is not selected and is not *entirely* included in the fiscally constrained long range transportation plan or state implementation plan. The regional conformity process for I-70 East will be completed as part of the Final EIS when a preferred alternative is selected and funding is identified.





Because the project area is also designated attainment/maintenance for both CO and PM10, project level conformity must be demonstrated before the Record of Decision is completed. The approval of this methodology to utilize a single worst-case intersection for CO conformity demonstration with the NAAQS will ultimately be reflected in the project NEPA documents and the results will be provided to Colorado Department of Public Health and Environment-Air Pollution Control Division (APCD) for their concurrence per standard protocols once completed.

## I-70 East Project History and Revisions

The Draft EIS was released for public review in November 2008. Because there was no strong support for any of the evaluated alternatives, the project team reviewed the alternatives in more detail to identify critical issues and confirm the validity of the analysis. As a result of this review, the 2008 Draft EIS alternatives were modified and a new alternative was developed that met the project's purpose, need, goals, and objectives and also satisfied the public and stakeholder's expectations.

Based on the outcome of the 2008 Draft EIS comments and additional outreach, the Current Alignment Alternative (Figure 1) was revised to further reduce the footprint of impacts, the Realignment Alternatives were eliminated from further consideration, and a new alternative for the Current Alignment Alternative was introduced – the Partial Cover Lowered option (PCL).

Figure 1 Supplemental Draft EIS Alternatives Summary

Alternative/Option	Description/Key Features
 <b>No-Action</b> No-Action North No-Action South	<ul style="list-style-type: none"> <li>Replace the viaduct between Brighton Boulevard and Colorado Boulevard without any added capacity, the remainder of the highway will reflect existing conditions and include existing, planned, and programmed roadway and transit improvements (such as FasTracks) in the project area</li> </ul>
 <b>Current Alignment Revised Viaduct</b> Revised Viaduct North Revised Viaduct South	<ul style="list-style-type: none"> <li>Add capacity in each direction through the entire corridor from I-25 to Tower Road</li> <li>Eliminate York Street interchange</li> <li>North-south connectivity via York Street, Josephine Street, Columbine Street, Fillmore Street, Clayton Street, Milwaukee Street, and Steele Street/Vasquez Boulevard</li> <li>46th Avenue is located under the viaduct</li> </ul>
 <b>Current Alignment Partial Cover Lowered</b>	<ul style="list-style-type: none"> <li>Add capacity in each direction through the entire corridor from I-25 to Tower Road</li> <li>Lower highway between Brighton Boulevard and Colorado Boulevard with partial cover</li> <li>Place a cover over the highway between Columbine Street and Clayton Street with urban landscape on top</li> <li>North-south connectivity via York Street, Josephine Street, Columbine Street, Clayton Street, and Steele Street/Vasquez Boulevard</li> <li>46th Avenue located adjacent to the highway on each side</li> </ul>
 <b>Current Alignment Managed Lanes</b>	<ul style="list-style-type: none"> <li>Add two managed lanes in each direction to increase capacity between Brighton Boulevard and Peña Boulevard</li> <li>Add one managed lane in eastbound direction off I-70 from I-25 to Brighton Boulevard</li> <li>Managed lanes will be separated from general-purpose lanes by a striped buffer</li> <li>Pricing on managed lanes will be adjusted based on real time demands</li> <li>Direct connection from the managed lanes to I-270, I-225, and Peña Boulevard</li> </ul>

The original Draft EIS project-level hot spot modeling for CO was performed to assess the future project impacts to CO concentrations at three signalized interchanges in the I-70 corridor for multiple proposed build alternatives. Emission rates were calculated by APCD with MOBILE 6.2, employing inputs from CDPHE's State Implementation Plan revision modeling, so that it was consistent with other emissions inventories within the Denver region. Project years 2010, 2020, and 2030 were analyzed.

Three interchanges (5 total analyses) selected through interagency consultation were analyzed in the I-70 East Draft EIS based on having the highest peak-hour traffic volumes with the worst congested level of service existing in 2030 and therefore would represent overall worst-case operating conditions. The intersection configurations were modeled at each intersection. Since these locations were shown to comply with the eight-hour CO standard, it was assumed that all other interchanges would also meet the standard. The intersection dispersion modeling was performed using CAL3QHC. The 8-hour CO hot spot results from the I-70 East Draft EIS are recorded in Table 1.

Table 1 Draft EIS Alternatives 1 and 3

Location	Year	Modeled Concentration, ppm	Background Concentration, ppm	Total Concentration, ppm
I-70 at Steele Street	2010	2.5	3.5	6.0
	2020	2.1	2.9	5.0
	2030	2.2	3.0	5.2
I-70 at Colorado Boulevard	2010	3.2	3.5	6.7
	2020	2.8	2.9	5.7
	2030	3.0	3.0	6.0
I-70 at Peoria Street	2010	2.9	3.5	6.4
	2020	2.4	2.9	5.3
	2030	2.6	3.0	5.6

Draft EIS Realignment Alternatives (4 and 6)

Location	Year	Modeled Concentration, ppm	Background Concentration, ppm	Total Concentration, ppm
I-70 at Colorado Boulevard	2010	2.4	3.5	5.9
	2020	2.1	2.9	5.0
	2030	2.0	3.0	5.0
46th Avenue at Steele Street	2010	2.0	3.5	5.5
	2020	1.8	2.9	4.7
	2030	2.0	3.0	5.0

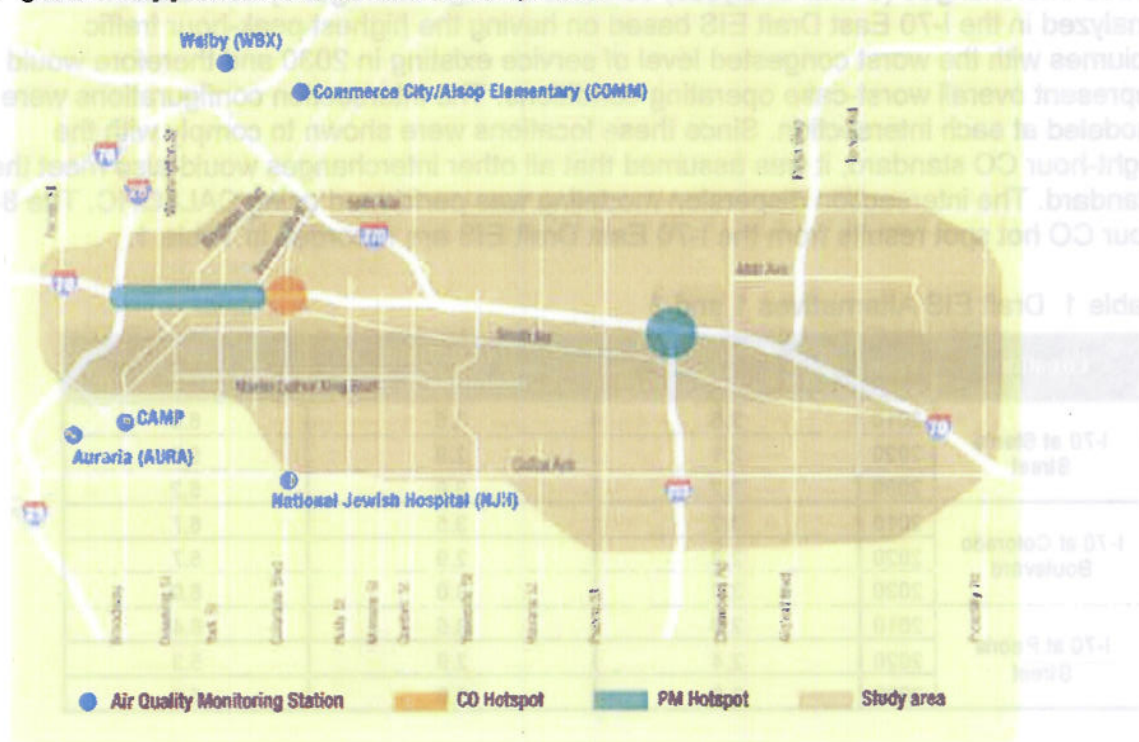
### Regulatory Changes

Since the publication of the I-70 East Draft EIS, a new emissions model (MOVES) has been designated as the required model for demonstrating conformity for air quality

### Methodology for Supplemental CO Hot Spot

Sufficient changes in environmental conditions since the I-70 East Draft EIS resulted in a need for a **Supplemental Draft EIS** to reevaluate the analyses conducted in the earlier document. This new **Supplemental Draft EIS** will update traffic volumes to a planning year horizon from 2030 to 2035. Traffic volumes will be projected using the latest DRCOG transportation planning assumptions for supporting MOVES emissions modeling inputs.

**Figure 2 Supplemental Draft EIS Study Area**



Because the remaining I-70 East alternatives have already undergone hot spot analyses for three major interchanges for years 2010, 2020, and 2030, with results below the NAAQS, and because emissions rates are expected to continue to decrease in future years due to improved Corporate Average Fuel Economy (CAFE) standards and engine/fuel technologies, a notable increase in intersection CO hot spot concentrations for the highest expected emissions year of 2035 (compared to the 2010, 2020 and 2030 analyses) seems unlikely in spite of projected VMT increase.

The results of I-70 East **Supplemental Draft EIS** hotspot analyses show that CO concentrations at Colorado Boulevard (Figure 2) are less than 5.8 ppm for all build alternatives and the No Action condition; below the NAAQS (Table 2).

**Table 2 Results from Proposed CO Hotspot**

Alternative	Peak Period	Modeled Conc. (ppm)	Background Conc. (ppm)	Total Conc. (ppm)
No Action	AM	1.6	3	4.6
	PM	1.6	3	4.6
Partial Cover Lowered	AM	2.8	3	5.8
	PM	2.6	3	5.6
Viaduct North	AM	1.9	3	4.9
	PM	1.9	3	4.9
Viaduct South	AM	2.1	3	5.1
	PM	1.9	3	4.9

The Final EIS will include micro-simulation traffic modeling (*Dynus7*) to compare operational conditions, which will be used to verify that the selection of Colorado Boulevard is the appropriate worse-case operations along the corridor. If refined traffic modeling results indicate a different location should be evaluated for hotspot, that modification will be vetted through interagency consultation and be included in the Final EIS documentation.

If the worse-case hot spot intersection results in a CO concentration below the NAAQS, then it can be assumed that the lower volume, better operating intersections along the corridor would also have an 8-hour CO concentration below the NAAQS. If the worse-case scenario results are equal to or above the NAAQS, a conventional hotspot analysis would then be conducted for 2035 and interim 2020 years.

FHWA and CDOT have attempted to satisfy the requirements of section 93.123 of the transportation conformity rule and request the EPA approval of this I-70 East **Supplemental Draft** EIS analytical methodology for CO hot spot analysis. This methodology was presented to representatives from FHWA, EPA and APCD, and approved by attendees, at a project coordination meeting on December 11, 2012.

Sincerely,



Jane Hann  
Branch Manager

Cc: / T. Russ, EPA  
W. Haas, FHWA  
C. Horn, FHWA  
J. Dileo, APCD  
K. Webb, CDOT



# **Attachment J – Appendix C**

## **MOVES Run Specifications for the CO**

### **Hotspot Analysis**



# Appendix C: MOVES Run Specifications for the CO Hotspot Analysis

Run Specifications (“RunSpecs”) were developed for each MOVES run. The RunSpec consists of sets of input options that define data to be used in the analysis. The following data items are included in the RunSpec:

## Description

The description panel was used to identify the project/alternative, pollutant, the time period, and the type of link being analyzed.

## Scale

When using AERMOD, a grams/hour emission factor is needed. Therefore, “Inventory,” which produces results for PM-10 emissions on each link, was selected. Since CAL3QHC requires emission rates in terms of both grams per vehicle-mile for free-flow links and grams per hour for queue links, Inventory was selected as output for the screening analyses of intersections.

## Time Spans

The Time Spans panel is used to define the specific time period covered in the MOVES run. The MOVES model processes one hour, of one day, of one month, of one year for each run. In other words, each MOVES run represents one specific hour.

For the CO hotspot analysis, time aggregation was set to “hour,” which indicates no pre-aggregation. The “day” selection was set to “weekday”. The year, month, and hour was set to specifically describe the peak traffic scenario. For example, the run describing the morning peak traffic scenario was set to be: 2010, January, 8:00 a.m. to 8:59 a.m. This directs the model to simulate 8:00 a.m. to 9:00 a.m. for the morning peak period. For the evening peak period, 5:00 p.m. to 5:59 p.m. was used.

## Geographic Bounds

The Geographic Bounds panel requires the user to define the specific county that will be modeled. Only a single county (or single custom domain) can be included in a MOVES run at the project level. For the CO hotspot analysis, Denver County was selected. The guidance (EPA-420-B-10-041) describes three options for modeling a project in more than one county. The first option was selected, which calls for the selection of the county in which the majority of the project is located if the county-specific data are the same for all counties in the project area. This project spans multiple counties (Denver, Adams, Arapahoe), although the majority of the project lies within Denver County. Furthermore, this option is appropriate because the Denver county-specific fuel and age distribution data are the same for all the counties in the Denver Metropolitan Area and, therefore, in the project area.

## Vehicles, Equipment, and Fuel Type

The Vehicles/Equipment panel is used to specify the vehicle types that are included in the MOVES run. This project-level CO hotspot analysis includes all vehicle types that are expected to operate in the project area. This was accomplished by selecting all of the appropriate fuel and vehicle type combinations in the Vehicle/Equipment panel, which reflects the full range of vehicles that will operate in the project area. Gasoline and diesel fuel types were chosen.

The following vehicles were selected:

- Motorcycle
- Passenger car
- Passenger truck
- Light commercial truck
- Refuse vehicle
- Motor home
- School bus
- Transit bus
- Intercity bus
- Single-unit long-haul truck
- Single-unit short-haul truck
- Combination long-haul truck
- Combination short-haul truck

### Road Type

The Road Type panel was used to define the types of roads that are included in the project. For this project, three road types were used:

- 1) Urban Restricted Access—an urban highway that can be accessed only by an on-ramp
- 2) Urban Unrestricted Access—all other urban roads (arterials, connectors, and local streets)
- 3) Off Network—for the Pilot truck stop

Rural road types were not selected as the project lies exclusively in an urban area. The road type designation determines the driving cycle used for the given roadway. This considers stop-and-go activity, acceleration, deceleration, cruising, idling, and other driving behavior. For this analysis, the default driving cycles were used.

### Pollutants and Processes

The Pollutants and Processes panel was used to select both the types of pollutants and the emission processes that produce them. In completing this CO screening analysis of an intersection project using CAL3QHC, both free-flow and queue links were characterized. For this analysis, MOVES was used to calculate CO pollutant emissions for two separate processes:

- 1) Running Exhaust
- 2) Crankcase Running Exhaust

Emission rates were post-processed from the MOVES output to calculate an aggregate emission factor containing both emission types (processes).

### Manage Input Databases

This input panel was not utilized for this analysis.

### Strategies

This input panel was not utilized for this analysis.

### Output

This panel allows the user to specify how they would like the MOVES output to be formatted, including what data it should contain and in what units of measure. Under the General Output pathway, “grams” and “miles” were selected for the output units to provide emissions rates for air quality modeling. Also,

“Distance Traveled” and “Population” were selected under the “Activity” heading to obtain vehicle volume information for each link in the output (i.e., to allow for the calculation of emissions rates in vehicle-grams per mile if desired). Under the “Output Emissions Detail” heading, the box labeled “Emission Process” was selected. This is necessary for post-processing the MOVES output as multiple emissions processes are being modeled and MOVES does not automatically calculate an aggregate emissions rate.

#### Advanced Performance Features

This input panel was not utilized for this analysis.

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# **Attachment J – Appendix D**

## **MOVES Input Data for the CO Hotspot Analysis**



# Appendix D: MOVES Input Data for the CO Hotspot Analysis

The MOVES input database tables, sources, and assumptions that contain the project details are described in this appendix. These tables are imported into the MOVES model runs using the Project Data Manager.

## Meteorology

Local meteorology data were used for the CO hotspot analysis. Temperature and humidity data used as input to the CO hotspot analysis were obtained from the Denver International Airport weather station and are consistent with the EPA'S guidance that meteorology data must be representative of the Denver region. The same meteorology data were used in both the MOVES and CAL3QHC models. Temperature and humidity data are contained in the Appendix D Supplement.

## Vehicle Type and Age Distribution

Vehicle age distribution represents the percentage of vehicles by age for each calendar year (yearID) and vehicle type (sourceTypeID). The Age Distribution Importer was used to enter these data. The distribution of the vehicle age fractions must sum to 1.00 for each vehicle type and year. For this analysis, the latest available local age distribution assumptions from the CO State Implementation Plan were provided by APCD. The original source data are from the Colorado Department of Revenue and are consistent with those data used in the most recent conformity determination for the Denver region. The 2010 and 2035 vehicle age distributions are contained in the Appendix D Supplement.

## Fuel Specifications

The Fuel Supply Importer and Fuel Formulation Importer were used to enter the necessary information describing fuel type and fuel mix for each respective MOVES run. Per EPA guidance (EPA-420-B-10-041) in Section 2.4.3, the MOVES default fuel supply and formulation information were used for this project-level CO analysis. The importers are used to import the default fuel template.

## Inspection and Maintenance

This project falls within an area covered by an existing Inspection and Maintenance (I/M) program. As such, the MOVES Inspection and Maintenance Importer was used. The local I/M program input data were provided by APCD and are shown in the Appendix D Supplement.

## Link Source Type

The Link Source Type Importer defines the fraction of the link traffic volume that is represented by each vehicle type (source type). For this analysis, project-specific commercial traffic data were provided for each link from the intersection traffic data associated with each modeled alternative. These project-specific data were used in conjunction with the latest regional emissions analysis to develop a link source type by vehicle type for each link.

## Links

The Links Importer was used to define the individual roadway links. All links modeled were defined with unique IDs. Information on each link's length (in miles), traffic volume (units of vehicles per hour), average speed (miles per hour), and road grade (percent) were provided. The traffic data are from the DRCOG Compass model.

Consistent with the *1992 Guideline*, to produce emission rates for a CO screening analysis of an intersection, users performing such an analysis should calculate emissions based on average speeds.

The average speed defined for each link is internally matched with a MOVES default drive cycle based on that average speed, road grade, and road type and is used to calculate emissions.

The intersection free-flow links and queue link were defined as follows:

- Free-Flow Links—an average free-flow speed and traffic volume was defined for each free-flow link that reflected conditions at peak traffic periods
- Queue Links—queue links were assigned an average speed of zero, indicating entirely idle operation

### Describing Vehicle Activity

MOVES determines vehicle emissions based on operating modes, which represent different types of vehicle activity: acceleration (at different rates), deceleration, idle, and cruise conditions. These operating conditions have distinct emission rates. MOVES handles these data in the form of a distribution of the time vehicles spend in different operating modes. This capability is central to the use of MOVES for hotspot analyses because it allows for the analysis of fine distinctions between vehicle behavior and emissions before and after construction of the project. For this analysis, the average speed and road type were provided through the Links input. Speeds are from the DRCOG Compass model. Using this approach, MOVES calculates emissions based on a default drive cycle for a given speed, grade, and road type.

## **Appendix D Supplement**

### **MOVES Input Data Assumptions**

**for the**

### **CO Hotspot Analysis**

## Temperature and Humidity

Month ID	Month	Zone ID	Hour	Temperature (degrees Fahrenheit)	Percent Relative Humidity
1	January	80310	1	31.55	55.09%
1	January	80310	2	31.81	53.22%
1	January	80310	3	32.74	55.05%
1	January	80310	4	32.00	55.87%
1	January	80310	5	32.16	56.73%
1	January	80310	6	31.84	55.40%
1	January	80310	7	30.40	53.67%
1	January	80310	8	30.90	51.54%
1	January	80310	9	33.76	45.89%
1	January	80310	10	36.48	42.44%
1	January	80310	11	38.97	40.44%
1	January	80310	12	40.34	38.81%
1	January	80310	13	41.29	36.62%
1	January	80310	14	41.93	38.00%
1	January	80310	15	41.92	41.46%
1	January	80310	16	39.38	39.67%
1	January	80310	17	38.44	44.63%
1	January	80310	18	37.67	50.58%
1	January	80310	19	36.26	46.81%
1	January	80310	20	34.63	50.79%
1	January	80310	21	33.31	51.30%
1	January	80310	22	32.32	50.67%
1	January	80310	23	31.80	52.08%

## Vehicle Age Distribution - 2010

Vehicle Age (relative to year)	Motorcycle	Passenger Car	Passenger Truck	Light Commercial Truck	Intercity Bus
	11	21	31	32	41
0	0.40%	2.04%	2.05%	1.90%	2.36%
1	1.94%	4.97%	4.36%	3.87%	0.67%
2	5.59%	4.43%	2.97%	3.06%	2.24%
3	6.87%	5.10%	6.04%	6.06%	6.29%
4	8.13%	5.51%	6.28%	6.27%	6.73%
5	7.09%	5.67%	6.08%	6.39%	12.68%
6	6.75%	5.72%	6.69%	6.66%	8.75%
7	5.58%	5.57%	7.00%	7.15%	5.95%
8	7.23%	5.83%	6.26%	6.45%	1.91%
9	5.96%	6.24%	6.70%	6.66%	1.80%
10	5.17%	5.98%	6.38%	6.50%	7.30%
11	4.35%	5.92%	6.18%	6.09%	27.61%
12	3.64%	5.10%	5.53%	5.59%	3.25%
13	2.74%	4.45%	4.41%	4.13%	5.39%
14	2.26%	4.10%	3.89%	3.99%	1.01%
15	2.02%	3.37%	2.95%	2.94%	0.11%
16	1.72%	3.24%	2.77%	2.84%	0.22%
17	1.38%	2.45%	2.32%	2.29%	0.45%
18	1.31%	2.13%	1.76%	1.73%	0.34%
19	1.03%	1.80%	1.27%	1.31%	0.56%
20	0.81%	1.57%	1.13%	1.11%	0.56%
21	0.79%	1.27%	0.94%	0.96%	0.11%
22	0.81%	0.88%	0.83%	0.89%	0.45%
23	0.70%	0.68%	0.68%	0.68%	0.00%
24	0.81%	0.54%	0.49%	0.49%	0.00%
25	1.24%	0.43%	0.45%	0.48%	0.67%
26	1.21%	0.32%	0.36%	0.39%	0.11%
27	0.96%	0.26%	0.30%	0.35%	0.22%
28	1.24%	0.16%	0.18%	0.19%	0.34%
29	1.76%	0.12%	0.14%	0.18%	0.22%
30+	8.50%	4.14%	2.62%	2.40%	1.68%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distribution - 2010

Vehicle Age (relative to year)	Transit Bus	School Bus	Refuse Truck	Single Unit Short- haul Truck	Single Unit Long- haul Truck
	42	43	51	52	53
0	2.66%	2.80%	2.50%	1.18%	1.16%
1	0.89%	2.92%	1.88%	2.78%	2.32%
2	2.31%	4.83%	4.38%	6.04%	6.63%
3	5.68%	9.27%	3.75%	4.27%	3.32%
4	5.86%	7.84%	6.88%	9.27%	7.96%
5	13.14%	8.75%	6.88%	7.32%	7.13%
6	7.28%	5.41%	4.38%	7.37%	7.79%
7	5.68%	8.45%	4.38%	5.80%	4.98%
8	1.24%	4.74%	4.38%	4.44%	4.31%
9	2.13%	4.89%	4.38%	4.11%	6.14%
10	7.64%	5.17%	5.63%	4.91%	5.47%
11	27.53%	5.96%	11.25%	7.11%	8.13%
12	2.13%	3.34%	9.38%	6.45%	6.80%
13	5.51%	3.95%	4.38%	4.30%	4.81%
14	0.53%	3.89%	1.88%	3.25%	3.81%
15	1.07%	1.22%	4.38%	2.47%	1.00%
16	0.71%	2.22%	4.38%	3.66%	4.48%
17	1.07%	1.52%	3.13%	1.97%	1.33%
18	1.07%	1.31%	3.75%	1.82%	2.82%
19	0.89%	1.22%	0.63%	1.51%	1.49%
20	0.00%	1.09%	1.88%	1.71%	1.49%
21	0.71%	2.58%	0.63%	1.62%	1.16%
22	0.89%	1.12%	0.00%	1.08%	1.16%
23	0.36%	0.70%	0.00%	1.01%	0.66%
24	0.18%	0.73%	0.00%	0.95%	0.66%
25	0.18%	1.19%	1.25%	0.88%	0.33%
26	0.00%	0.33%	1.25%	0.73%	1.16%
27	0.00%	0.18%	0.63%	0.56%	0.66%
28	0.71%	0.18%	0.00%	0.26%	0.00%
29	0.36%	0.61%	0.63%	0.53%	0.50%
30+	1.60%	1.58%	1.25%	0.67%	0.33%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distribution - 2010

Vehicle Age (relative to year)	Motor Home	Combination Short-haul Truck	Combination Long-haul Truck
	54	61	62
0	1.33%	1.48%	1.46%
1	2.67%	2.75%	2.04%
2	5.94%	4.27%	2.51%
3	5.45%	4.07%	3.55%
4	8.85%	8.62%	7.87%
5	7.88%	5.99%	5.30%
6	5.45%	7.31%	6.47%
7	8.00%	4.87%	4.02%
8	5.70%	3.87%	5.48%
9	3.64%	3.63%	3.90%
10	3.76%	4.71%	5.77%
11	6.18%	7.86%	8.97%
12	6.42%	5.75%	7.40%
13	3.76%	4.15%	4.08%
14	3.03%	3.75%	4.37%
15	1.82%	3.31%	3.96%
16	3.52%	4.63%	4.20%
17	1.58%	2.91%	3.32%
18	1.70%	2.79%	3.32%
19	1.21%	1.76%	1.92%
20	2.79%	2.12%	1.28%
21	1.45%	1.68%	1.34%
22	0.00%	1.40%	1.40%
23	1.70%	0.88%	1.40%
24	1.70%	0.88%	0.82%
25	0.73%	1.24%	0.93%
26	0.85%	1.04%	1.11%
27	0.73%	0.56%	0.41%
28	0.48%	0.52%	0.17%
29	0.61%	0.12%	0.52%
30+	1.09%	1.08%	0.70%
Total	100.00%	100.00%	100.00%

## Vehicle Age Distributions - 2035

ageID	Motorcycle	Passenger Car	Passenger Truck	Light Commercial Truck	Intercity Bus
	11	21	31	32	41
0	0.40%	2.04%	2.05%	1.90%	2.36%
1	1.94%	4.97%	4.36%	3.87%	0.67%
2	5.59%	4.43%	2.97%	3.06%	2.24%
3	6.87%	5.10%	6.04%	6.06%	6.29%
4	8.13%	5.51%	6.28%	6.27%	6.73%
5	7.09%	5.67%	6.08%	6.39%	12.68%
6	6.75%	5.72%	6.69%	6.66%	8.75%
7	5.58%	5.57%	7.00%	7.15%	5.95%
8	7.23%	5.83%	6.26%	6.45%	1.91%
9	5.96%	6.24%	6.70%	6.66%	1.80%
10	5.17%	5.98%	6.38%	6.50%	7.30%
11	4.35%	5.92%	6.18%	6.09%	27.61%
12	3.64%	5.10%	5.53%	5.59%	3.25%
13	2.74%	4.45%	4.41%	4.13%	5.39%
14	2.26%	4.10%	3.89%	3.99%	1.01%
15	2.02%	3.37%	2.95%	2.94%	0.11%
16	1.72%	3.24%	2.77%	2.84%	0.22%
17	1.38%	2.45%	2.32%	2.29%	0.45%
18	1.31%	2.13%	1.76%	1.73%	0.34%
19	1.03%	1.80%	1.27%	1.31%	0.56%
20	0.81%	1.57%	1.13%	1.11%	0.56%
21	0.79%	1.27%	0.94%	0.96%	0.11%
22	0.81%	0.88%	0.83%	0.89%	0.45%
23	0.70%	0.68%	0.68%	0.68%	0.00%
24	0.81%	0.54%	0.49%	0.49%	0.00%
25	1.24%	0.43%	0.45%	0.48%	0.67%
26	1.21%	0.32%	0.36%	0.39%	0.11%
27	0.96%	0.26%	0.30%	0.35%	0.22%
28	1.24%	0.16%	0.18%	0.19%	0.34%
29	1.76%	0.12%	0.14%	0.18%	0.22%
30+	8.50%	4.14%	2.62%	2.40%	1.68%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distributions - 2035

ageID	Transit Bus	School Bus	Refuse Truck	Single Unit Short-haul Truck	Single Unit Long- haul Truck
	42	43	51	52	53
0	2.66%	2.80%	2.50%	1.18%	1.16%
1	0.89%	2.92%	1.88%	2.78%	2.32%
2	2.31%	4.83%	4.38%	6.04%	6.63%
3	5.68%	9.27%	3.75%	4.27%	3.32%
4	5.86%	7.84%	6.88%	9.27%	7.96%
5	13.14%	8.75%	6.88%	7.32%	7.13%
6	7.28%	5.41%	4.38%	7.37%	7.79%
7	5.68%	8.45%	4.38%	5.80%	4.98%
8	1.24%	4.74%	4.38%	4.44%	4.31%
9	2.13%	4.89%	4.38%	4.11%	6.14%
10	7.64%	5.17%	5.63%	4.91%	5.47%
11	27.53%	5.96%	11.25%	7.11%	8.13%
12	2.13%	3.34%	9.38%	6.45%	6.80%
13	5.51%	3.95%	4.38%	4.30%	4.81%
14	0.53%	3.89%	1.88%	3.25%	3.81%
15	1.07%	1.22%	4.38%	2.47%	1.00%
16	0.71%	2.22%	4.38%	3.66%	4.48%
17	1.07%	1.52%	3.13%	1.97%	1.33%
18	1.07%	1.31%	3.75%	1.82%	2.82%
19	0.89%	1.22%	0.63%	1.51%	1.49%
20	0.00%	1.09%	1.88%	1.71%	1.49%
21	0.71%	2.58%	0.63%	1.62%	1.16%
22	0.89%	1.12%	0.00%	1.08%	1.16%
23	0.36%	0.70%	0.00%	1.01%	0.66%
24	0.18%	0.73%	0.00%	0.95%	0.66%
25	0.18%	1.19%	1.25%	0.88%	0.33%
26	0.00%	0.33%	1.25%	0.73%	1.16%
27	0.00%	0.18%	0.63%	0.56%	0.66%
28	0.71%	0.18%	0.00%	0.26%	0.00%
29	0.36%	0.61%	0.63%	0.53%	0.50%
30+	1.60%	1.58%	1.25%	0.67%	0.33%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distributions - 2035

ageID	Motor Home	Combination Short-haul Truck	Combination Long-haul Truck
	54	61	62
0	1.33%	1.48%	1.46%
1	2.67%	2.75%	2.04%
2	5.94%	4.27%	2.51%
3	5.45%	4.07%	3.55%
4	8.85%	8.62%	7.87%
5	7.88%	5.99%	5.30%
6	5.45%	7.31%	6.47%
7	8.00%	4.87%	4.02%
8	5.70%	3.87%	5.48%
9	3.64%	3.63%	3.90%
10	3.76%	4.71%	5.77%
11	6.18%	7.86%	8.97%
12	6.42%	5.75%	7.40%
13	3.76%	4.15%	4.08%
14	3.03%	3.75%	4.37%
15	1.82%	3.31%	3.96%
16	3.52%	4.63%	4.20%
17	1.58%	2.91%	3.32%
18	1.70%	2.79%	3.32%
19	1.21%	1.76%	1.92%
20	2.79%	2.12%	1.28%
21	1.45%	1.68%	1.34%
22	0.00%	1.40%	1.40%
23	1.70%	0.88%	1.40%
24	1.70%	0.88%	0.82%
25	0.73%	1.24%	0.93%
26	0.85%	1.04%	1.11%
27	0.73%	0.56%	0.41%
28	0.48%	0.52%	0.17%
29	0.61%	0.12%	0.52%
30+	1.09%	1.08%	0.70%
Total	100.00%	100.00%	100.00%

## Inspection and Maintenance Program Parameters

pol Process ID	state ID	county ID	year ID	source Type ID	fuel Type ID	IM Program ID	inspect Freq	test Standards ID	beg Model Year ID	end Model Year ID	use IMyn	compliance Factor
201	8	8031	2035	21	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	21	1	6	2	33	1982	2033	Y	93.12
201	8	8031	2035	31	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	31	1	6	2	33	1982	2033	Y	93.12
201	8	8031	2035	32	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	32	1	6	2	33	1982	2033	Y	93.12
201	8	8031	2035	52	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	52	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	21	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	21	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	31	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	31	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	32	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	32	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	52	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	52	1	6	2	33	1982	2033	Y	93.12

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# **Attachment J – Appendix E**

## **Pilot Truck Stop Data for the PM<sub>10</sub>**

### **Hotspot Analysis**



# Appendix E: Data Collection Results at Pilot Travel Center Truck Stop

To support the air quality analysis of the I-70 alternatives, data collection at the Pilot Travel Center truck stop was conducted. The truck stop is located at the northeast corner of I-70/46<sup>th</sup> Avenue and Vasquez Boulevard/Steele Street (see the aerial map below). There are two driveways providing access to the property: one on the west side of the property at Steele Street, and another on the south edge toward the east side of the property at 46<sup>th</sup> Avenue.



There is also a Wendy's restaurant with a drive-through lane integrated into the truck stop. In addition, there are gas pump stations and a convenience store accessed by personal vehicles.

The information to collect included:

- Extended idling data, including the number of trucks parked overnight, diesel truck engine idling, on-board auxiliary power unit use, and duration; this truck stop does not have station-provided power or heating/cooling
- Basic data on truck arrivals and departures by time of day
- Capacity of the truck stop to accommodate overnight parking and other site characteristics

The data collection effort started with initially contacting the truck stop manager to introduce the project, explaining the need to obtain data, getting any data that may be available from the owner/manager, and requesting permission to collect additional data. Through several communications that moved up the company hierarchy, an attorney for Pilot finally explained that no cameras or interviewing were allowed on company property.

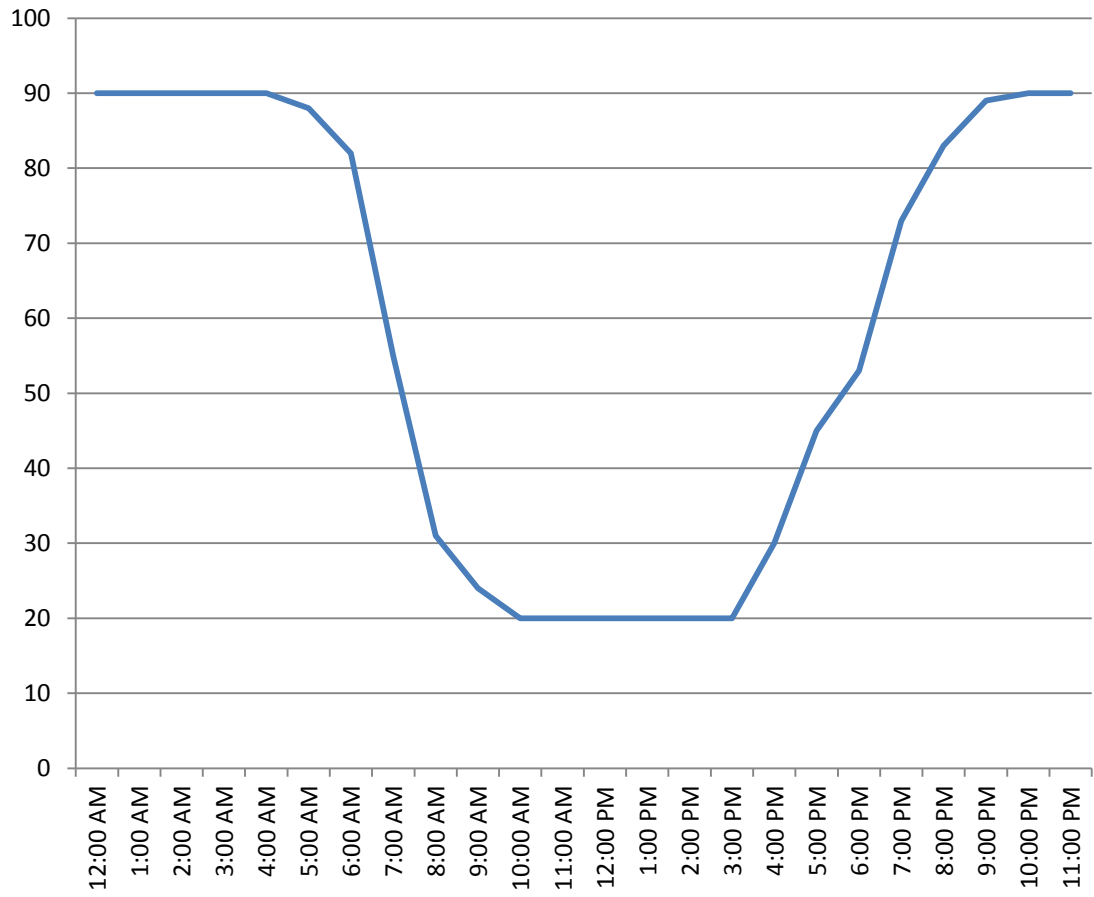
During the initial contact with the truck stop manager—and with his approval (at the time)—short interviews were conducted with five truck drivers. Results of this informal survey follow:

- All five of the drivers either had stayed at the truck stop the previous night or were staying that night. At least two had auxiliary power units (APU).
- Of the five drivers, four appeared to be independent drivers and one appeared to be a corporate driver.
- During the winter months (i.e., January), all five of the drivers indicated that they typically would not idle their engines for cab/sleeping comfort unless the temperature dropped below freezing, and only then because of fuel gelling issues. Generally, the drivers indicated that the temperature would need to be very cold (below 20 degrees) at night before using the engine for warmth. In addition, all drivers cited the expense of idling overnight due to fuel consumption.
- APUs generally are not used in the winter because the fuel gelling issue trumps the warmth/comfort issue. APUs typically are used for cooling in the summer months depending on the temperature where the truck engine would not need to be running. As a side note, two of the drivers said they would typically idle their engines to mask the noise created by the APUs. Diesel truck engines idle at one speed, thus producing a steady, droning white noise. In contrast, APUs are load sensitive and change speeds frequently, which can be annoying to other drivers, especially those with their windows down.
- The truck stop manager indicated that the parking lot was always full on Sunday nights through Wednesday nights. Thursday night tapered off somewhat, and Friday and Saturday nights typically saw low use.

A follow-up effort involved stationing a person at the truck stop to visually observe the activities while not violating the company's policies regarding interviews and photos. Results from that collection effort follow:

- The truck stop has spaces for approximately 90 rigs to park overnight.
- The truck stop parking lot was full at 5:00 a.m.
- Very little movement occurred from 5:00 a.m. to 5:45 a.m. Two small activity peaks occurred between 5:45 a.m. and 7:00 a.m. and between 7:30 a.m. and 8:45 a.m.
- The minimum number of trucks in the parking lot during the day is estimated to be 20. Based on driver input, departure times depend on the location and timing of their shipment pickup or dropoff.
- The use/vacancy curve is estimated as follows:

## Trucks in Pilot Truck Stop Parking Lot



Number of Trucks in the Parking Lot By Hour (90-space capacity)	
Start Time	Trucks in the Parking Lot
12:00 a.m.	90
1:00 a.m.	90
2:00 a.m.	90
3:00 a.m.	90
4:00 a.m.	90
5:00 a.m.	88
6:00 a.m.	82
7:00 a.m.	55
8:00 a.m.	31
9:00 a.m.	24
10:00 a.m.	20
11:00 a.m.	20
12:00 p.m.	20
1:00 p.m.	20
2:00 p.m.	20
3:00 p.m.	20
4:00 p.m.	30
5:00 p.m.	45
6:00 p.m.	53
7:00 p.m.	73
8:00 p.m.	83
9:00 p.m.	89
10:00 p.m.	90
11:00 p.m.	90

### Summary

- Extended idling data, including the number of trucks parked overnight, diesel truck engine idling, on-board auxiliary power unit use, and duration:
  - For winter months on a typical weekday, the number of trucks is 90 (lot 100% full). APU use is estimated at zero (0%). Diesel engine idling is estimated at 100% if the average temperature is below 32 degrees Fahrenheit, and it is estimated at zero (0%) otherwise.
- Basic data on truck arrivals and departures by time of day:
  - See chart above
- Capacity of the truck stop to accommodate overnight parking and other site characteristics:
  - Truck stop capacity is estimated at 90 spaces for overnight big rig parking.

# **Attachment J – Appendix F**

## **Year of Peak PM<sub>10</sub> Emissions**



# Appendix F: Year of Peak PM<sub>10</sub> Emissions Analysis

Section 93.116(a) of the Transportation Conformity Rule (40 CFR 93) requires that PM<sub>10</sub> hotspot analyses consider the full time frame of an area's transportation plan. EPA's quantitative PM<sub>10</sub> hotspot guidance (EPA-420-B-10-040, December 2010) expands on this requirement by stating that the analysis should include the year(s) within the transportation plan during which peak emissions from the project are expected. The rule also describes the factors that should be considered when selecting the year(s) of peak emissions, including changes in vehicle fleets, traffic volumes, speeds, and vehicle miles of travel as well as expected trends in background concentrations.

The analysis year of 2035 was selected through the Interagency Consultation process as required by Section 93.116(c)(1)(i) of the Conformity Rule. However, the Interagency Consultation process also established the need to estimate the year of peak emissions through a comparison of emission factors and VMT for several interim years to either verify 2035 or determine the estimated year of peak emissions. If the year of peak emissions is not 2035, then the analysis would be conducted for the estimated peak year.

The year of peak emissions was determined through an aggregate estimation of emissions for every five years from 2010 through 2035. The EPA's MOVES model was run for each year to produce emission factors in grams per mile. The emission factors were multiplied by average weekday VMT for each year to produce an estimate of emissions for each interim year for comparison.

Based on the requirements, the regional transportation plan's horizon year of 2035 was modeled; and an analysis was conducted to estimate emissions for 2010 and interim years of 2015, 2020, 2025, and 2030. Project completion is anticipated to occur after 2020. Three areas were reviewed in the year of emissions analysis: (1) the air quality study area, (2) the I-70/I-25 PM<sub>10</sub> hotspot area, and (3) the I-70/I-225 PM<sub>10</sub> hotspot area.

## **Vehicle Miles of Travel for Peak Year Analysis**

The sources of VMT and speeds used in the year of peak emissions analysis were the 2010, 2015, 2025, 2030, and 2035 DRCOG Compass models. These are DRCOG's official base models and are consistent with the most recent conformity determinations for the regional transportation plan and transportation improvement program. Since the I-70 corridor improvements are not currently included in the regional conformity analysis, the official base DRCOG models do not include them. Compass models coded with the I-70 Build Alternatives were not available for the years 2020, 2025, or 2030.

To maintain an "apples-to-apples" comparison among analysis years, it was necessary to use the official base DRCOG models in the year of peak emissions analysis, which simulate No-Action conditions. Based on the results from PM<sub>10</sub> hotspot analysis and also from APCD for the criteria pollutant emissions burden analysis, the PM<sub>10</sub> emissions for all of the 2035 Build Alternatives are lower than the 2035 No-Action scenario. Therefore, it was assumed that the Build Alternatives would have lower PM<sub>10</sub> emissions than the No-Action Alternative for the prior years as well, i.e., 2020, 2025, and 2030. After the year of peak emissions was established, the Compass models with the Build Alternatives were used in the hotspot analysis.

The VMT figures from the DRCOG Compass models are shown in Table 1. The DRCOG model VMT represents a typical weekday with school in session. VMT for the years 2020 and 2030 was interpolated since Compass models were not available for these years. In addition, the interim year analysis utilizes VMT estimates by road type, speed bin, and time of day. These are shown in Tables 2, 3, and 4, respectively. Table 3 also includes the speed ranges associated with each speed bin.

**Table 1. Vehicle Miles of Travel (weekday)**

Description	2010	2015	2020	2025	2030	2035
<b>Study Area</b>						
Freeway	3,620,000	3,922,000	4,198,000	4,484,000	4,714,000	4,950,000
Non-freeway	3,287,000	3,873,000	4,283,000	4,718,000	5,008,000	5,307,000
<b>Total</b>	<b>6,907,000</b>	<b>7,795,000</b>	<b>8,481,000</b>	<b>9,202,000</b>	<b>9,722,000</b>	<b>10,257,000</b>
<b>I-70/I-25 Hotspot Area</b>						
Freeway	550,000	546,000	570,000	596,000	618,000	641,000
Non-freeway	175,000	194,000	203,000	211,000	218,000	225,000
<b>Total</b>	<b>725,000</b>	<b>740,000</b>	<b>773,000</b>	<b>807,000</b>	<b>836,000</b>	<b>866,000</b>
<b>I-70/I-225 Hotspot Area</b>						
Freeway	109,000	121,000	136,000	151,000	160,000	170,000
Non-freeway	113,000	128,000	136,000	144,000	150,000	156,000
<b>Total</b>	<b>222,000</b>	<b>249,000</b>	<b>272,000</b>	<b>295,000</b>	<b>310,000</b>	<b>326,000</b>

Source: DRCOG Compass base models

**Table 2. VMT Fractions by Road Type**

Road Type	2010	2015	2020	2025	2030	2035
Freeway	52.41%	50.32%	49.50%	48.73%	48.49%	48.26%
Non-Freeway	47.59%	49.68%	50.50%	51.27%	51.51%	51.74%

Source: DRCOG Compass base models

Table 3. VMT Fractions by Speed Bin

Speed Bin	Speed Range	2010	2015	2020	2025	2030	2035
<b>Freeways</b>							
1	speed < 2.5 mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2	2.5 mph <= speed < 7.5 mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
3	7.5 mph <= speed < 12.5 mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4	12.5 mph <= speed < 17.5 mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
5	17.5 mph <= speed < 22.5 mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
6	22.5 mph <= speed < 27.5 mph	0.00%	0.00%	0.00%	0.00%	2.35%	4.71%
7	27.5 mph <= speed < 32.5 mph	0.00%	0.00%	2.92%	5.85%	4.28%	2.71%
8	32.5 mph <= speed < 37.5 mph	0.00%	5.24%	3.40%	1.55%	2.12%	2.68%
9	37.5 mph <= speed < 42.5 mph	6.12%	0.97%	4.05%	7.12%	5.59%	4.05%
10	42.5 mph <= speed < 47.5 mph	0.99%	5.41%	7.17%	8.93%	10.56%	12.19%
11	47.5 mph <= speed < 52.5 mph	10.48%	15.62%	14.50%	13.38%	14.00%	14.63%
12	52.5 mph <= speed < 57.5 mph	21.83%	11.99%	18.12%	24.25%	23.24%	22.22%
13	57.5 mph <= speed < 62.5 mph	33.82%	40.80%	29.48%	18.17%	19.12%	20.06%
14	62.5 mph <= speed < 67.5 mph	22.98%	16.23%	16.81%	17.39%	15.24%	13.09%
15	67.5 mph <= speed < 72.5 mph	0.00%	2.99%	1.50%	0.00%	0.00%	0.00%
16	72.5 mph <= speed	3.78%	0.74%	2.05%	3.36%	3.51%	3.65%
<b>Non-Freeways</b>							
1	speed < 2.5 mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2	2.5 mph <= speed < 7.5 mph	0.03%	0.06%	0.05%	0.05%	0.05%	0.05%
3	7.5 mph <= speed < 12.5 mph	0.42%	0.06%	0.24%	0.41%	0.55%	0.70%
4	12.5 mph <= speed < 17.5 mph	6.82%	7.15%	7.59%	8.04%	8.63%	9.21%
5	17.5 mph <= speed < 22.5 mph	9.32%	9.10%	10.01%	10.91%	11.36%	11.82%
6	22.5 mph <= speed < 27.5 mph	10.45%	9.90%	11.22%	12.54%	13.71%	14.88%
7	27.5 mph <= speed < 32.5 mph	18.30%	15.68%	16.63%	17.59%	18.64%	19.69%
8	32.5 mph <= speed < 37.5 mph	32.96%	35.64%	33.15%	30.67%	29.71%	28.75%
9	37.5 mph <= speed < 42.5 mph	16.06%	16.12%	16.03%	15.94%	13.59%	11.24%
10	42.5 mph <= speed < 47.5 mph	1.83%	1.56%	1.26%	0.95%	0.93%	0.91%
11	47.5 mph <= speed < 52.5 mph	3.05%	2.38%	1.99%	1.60%	1.54%	1.49%
12	52.5 mph <= speed < 57.5 mph	0.00%	0.62%	0.45%	0.29%	0.41%	0.53%
13	57.5 mph <= speed < 62.5 mph	0.74%	1.73%	1.37%	1.01%	0.88%	0.75%
14	62.5 mph <= speed < 67.5 mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15	67.5 mph <= speed < 72.5 mph	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
16	72.5 mph <= speed	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Source: DRCOG Compass base models

**Table 4. VMT Fractions by Time of Day**

Hour	VMT Fraction
1	0.33%
2	0.21%
3	0.16%
4	0.20%
5	0.52%
6	1.67%
7	5.72%
8	10.56%
9	7.26%
10	4.25%
11	4.06%
12	4.68%
13	5.04%
14	4.91%
15	5.59%
16	6.97%
17	8.50%
18	11.25%
19	7.65%
20	3.92%
21	2.29%
22	2.09%
23	1.64%
24	0.52%

Source: DRCOG

#### **MOVES Modeling for the Year of Peak PM<sub>10</sub> Emissions Analysis**

The methods used to conduct MOVES modeling are consistent with EPA guidance, including EPA's *Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a and 2010b* (EPA-420-B-12-028, April 2012) and the *MOVES User Guide for MOVES2010b*. These guidance documents were used as references for organizing input data, determining appropriate settings and parameters for operating the model, and evaluating output data.

MOVES model run specification files were generated for each analysis year (2010, 2015, 2020, 2025, 2030, and 2035) and at three spatial levels (I-25 hotspot, I-225 hotspot, and Study Area). All model runs were performed in the "emissions rate" mode and at the county level for Denver County (County code 8031) for weekdays in January.

Databases were constructed for the input data required for analysis in the model. DRCOG Compass model data were used for VMT and speed inputs. Inputs created for MOVES included those data that involve VMT and road facilities within the study area, such as VMT by road type, VMT by speed bin, VMT by time-of-day, etc. Meteorological, fuel specification, fleet makeup, and vehicle inspection and maintenance program input data also are used in MOVES. MOVES does not provide a PM<sub>10</sub> emission benefit from inspection and maintenance (I/M) programs. As such, no I/M file was imported for the PM<sub>10</sub> analysis.

Pollutants used in the PM<sub>10</sub> year of peak emissions analysis are the same as those used for the PM<sub>10</sub> hotspot analysis: total exhaust, brake wear, and tire wear. Total exhaust includes tailpipe emissions for startup, extended idle, and running exhaust. When running the MOVES model in the emissions rate mode, the model reports emissions rates per distance (e.g., grams per mile) by month (January in this case), day (weekend or weekday), hour, road type, speed bin, and pollutant type.

The emission factors obtained from MOVES were multiplied by the VMT by speed bin, road type, and hour, shown previously, to estimate the PM<sub>10</sub> emission inventory for each five-year increment from 2010 through 2035. The VMT by road type and speed bin was obtained from the 2010, 2015, 2025, and 2035 base Compass models from DRCOG. The travel model data were interpolated to estimate VMT by speed bin and VMT by road type as needed by MOVES. The VMT by time of day was provided by DRCOG and is used for all model years.

### **Emissions Results for the Year of Peak PM<sub>10</sub> Emissions Analysis**

The results of the emissions estimates are shown in Table 5 and Figures 1, 2, and 3. As the table and charts indicate, PM<sub>10</sub> emissions are highest in 2035 for the Study Area as a whole, as well as the I-70/I-25 and I-70/I-225 hotspot areas. Thus the year of peak emissions was estimated to occur in 2035, and it can be assumed that the concentration results would be similar as well.

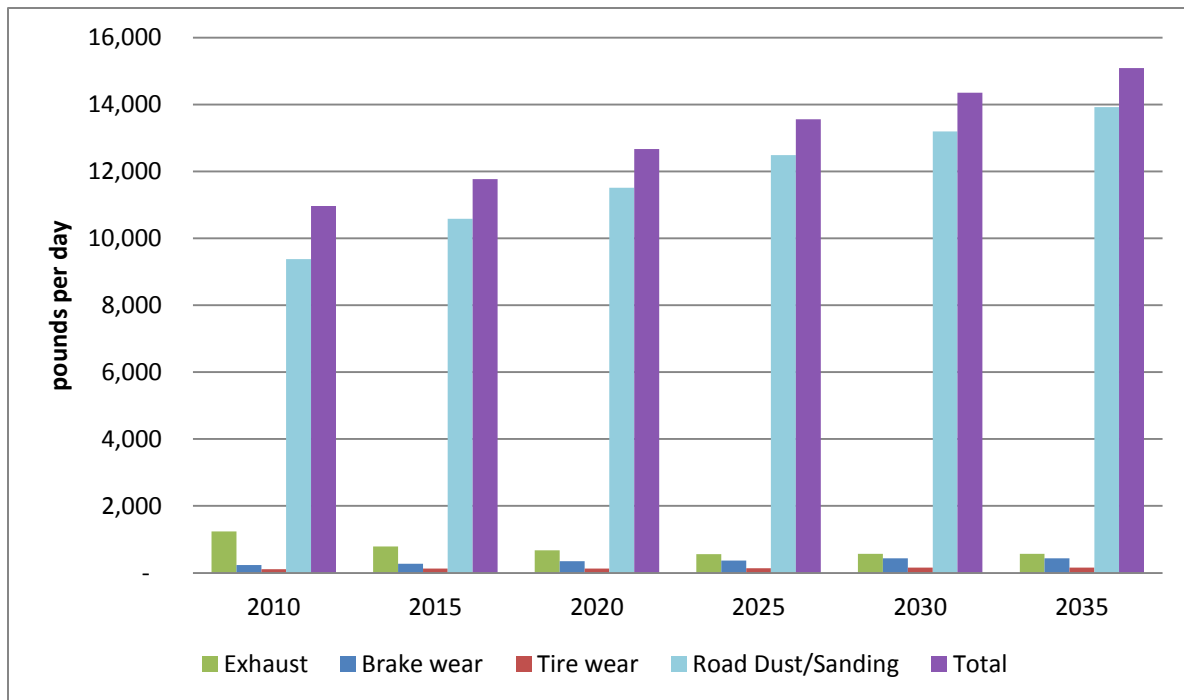
For road dust and road sanding emissions, calculation of emissions is complicated by the fact that the emissions factors used in the SIP are regional conformity vary by area type, road type, and road ownership (i.e., which agency is responsible for maintaining the road). Since the goal of this analysis is simply to document the trend in emissions, one average road dust emissions rate was used for the entire project area (unlike the actual hot-spot analysis, where link-specific emissions rates were used). This rate was calculated using the VMT and controlled sanding and road dust emissions estimates from Section 3.4 of the PM<sub>10</sub> SIP Technical Support Document (TSD). Calendar year 2025 values were used (the last year of data in the TSD), and the resulting emissions rate is 0.616 grams per mile.

The consideration of background PM<sub>10</sub> concentration trends further supports the use of 2035 as the year of peak emissions. In the CDPHE/APCD's *Colorado State Implementation Plan for PM<sub>10</sub>, Revised Technical Support Document* (September 2005), Table 5.1-1 shows a summary of maintenance year model demonstrations in which the sixth highest modeled concentration increases steadily from 2001 through at least 2030. Table 3.1-1 of that document also shows a steadily increasing total PM<sub>10</sub> emission inventory from 2001 through 2025. In that 2005 document, the analysis does not include 2035, but the evidence is clear—the overall PM<sub>10</sub> emission inventory is rising over time due to increases in almost all source types. It is reasonable to conclude that the year 2035 is the year of peak emissions to model for the PM<sub>10</sub> hotspot analysis.

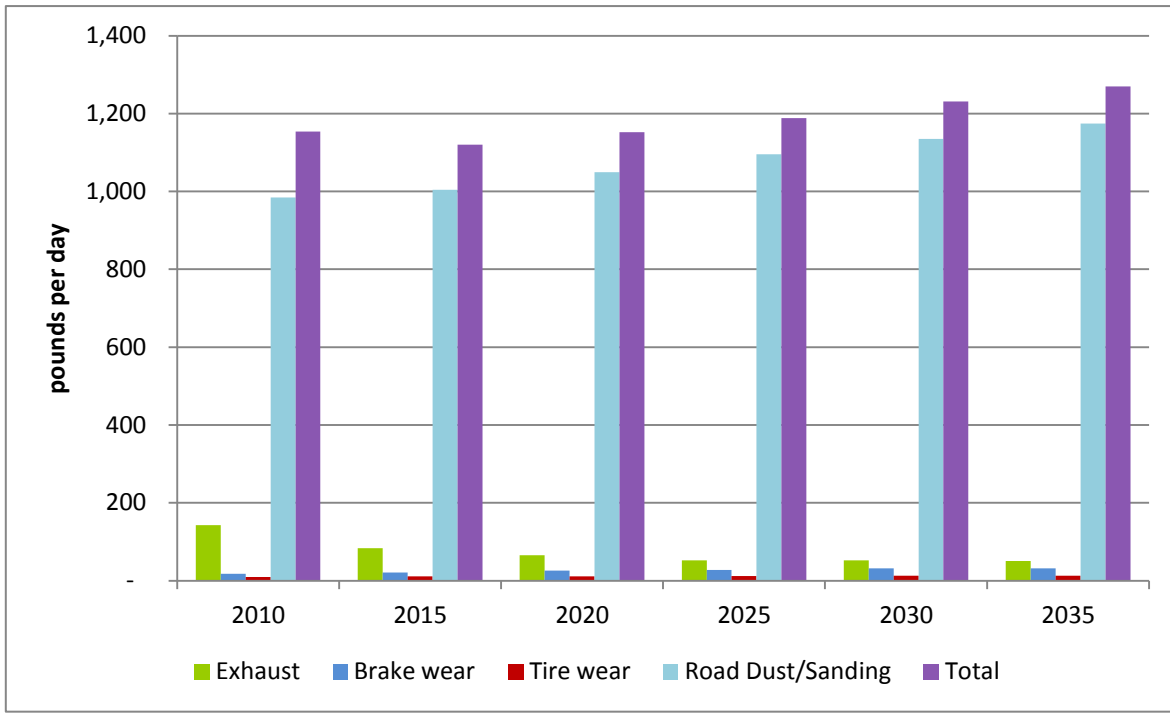
Table 5. PM<sub>10</sub> Emissions for Peak Year of Emissions Analysis (pounds per weekday)

Description	2010	2015	2020	2025	2030	2035
<b>Study Area</b>						
Freeway	5,745	5,886	6,176	6,525	6,849	7,181
Non-freeway	5,215	5,885	6,488	7,028	7,505	7,903
<b>Total</b>	<b>10,960</b>	<b>11,772</b>	<b>12,664</b>	<b>13,553</b>	<b>14,353</b>	<b>15,084</b>
<b>I-70/I-25 Hotspot Area</b>						
Freeway	878	825	844	872	<b>904</b>	<b>935</b>
Non-freeway	276	296	308	316	<b>327</b>	<b>335</b>
<b>Total</b>	<b>1,154</b>	<b>1,120</b>	<b>1,152</b>	<b>1,188</b>	<b>1,231</b>	<b>1,270</b>
<b>I-70/I-225 Hotspot Area</b>						
Freeway	173	180	198	218	<b>231</b>	<b>245</b>
Non-freeway	170	187	198	207	<b>217</b>	<b>225</b>
<b>Total</b>	<b>343</b>	<b>367</b>	<b>396</b>	<b>425</b>	<b>448</b>	<b>471</b>

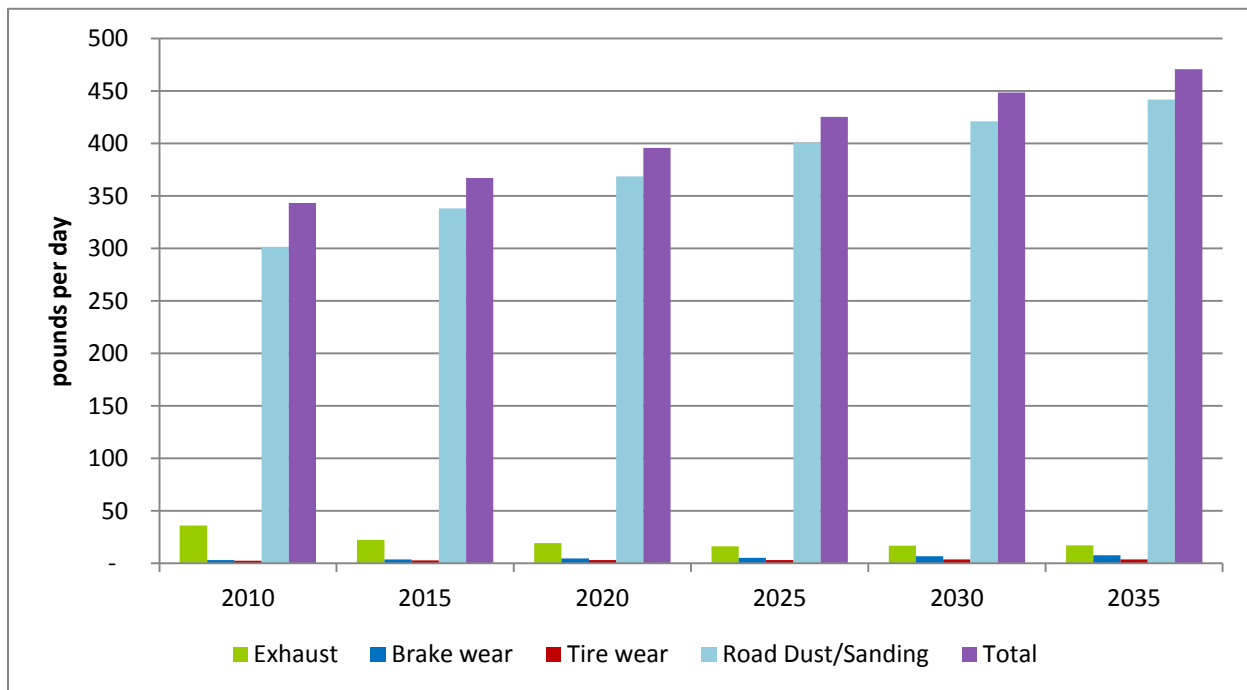
Figure 1. PM<sub>10</sub> Emissions for Peak Year of Emissions Analysis  
(Study Area, pounds per weekday)



**Figure 2. PM<sub>10</sub> Emissions for Peak Year of Emissions Analysis  
(I-70/I-25 Hotspot Area, pounds per weekday)**



**Figure 3. PM<sub>10</sub> Emissions for Peak Year of Emissions Analysis  
(I-70/I-225 Hotspot Area, pounds per weekday)**





# **Attachment J – Appendix G**

## **MOVES Run Specifications for the**

### **PM<sub>10</sub> Hotspot Analysis**



# Appendix G: MOVES Model Run Specifications for the PM<sub>10</sub> Hotspot Analysis

Run Specifications (“RunSpecs”) were developed for each MOVES run. The RunSpec consists of sets of input options that define data to be used in the analysis. The following data items are included in the RunSpec.

## **Description**

The description panel was used to identify the project/alternative, pollutant, the time period, and the type of link being analyzed.

## **Scale**

When using AERMOD, a grams/hour emission factor is needed. Therefore, “Inventory,” which produces results for PM<sub>10</sub> emissions on each link, was selected.

## **Time Spans**

The Time Spans panel is used to define the specific time period covered in the MOVES run. The MOVES model processes one hour, of one day, of one month, of one year for each run. In other words, each MOVES run represents one specific hour. Time aggregation was set to “hour,” which indicates no pre-aggregation. The “day” selection was set to “weekday.” The year, month, and hour was set to specifically describe the peak traffic scenario. For example, the run describing the morning peak traffic scenario was set to be: 2010, January, 8:00 a.m. to 8:59 a.m. (both the start and end hours set to “8:00 a.m. to 8:59 a.m.”). The MOVES model was used to calculate emissions rates for each of the four time periods for each of the alternatives. The hourly emissions rates derived for each time period were then extrapolated to represent all of the hours in that time period. For instance, the hourly morning peak traffic emissions rates calculated in the example above were used to represent emissions occurring from 6:00 a.m. to 9:00 a.m.

## **Geographic Bounds**

The Geographic Bounds panel allows the user to define the specific county that will be modeled. Only a single county (or single custom domain) can be included in a MOVES run at the project level. As this project spans multiple counties (Denver, Adams, Arapahoe), the option of selecting the county in which the majority of the project is located (Denver County) was utilized. This option is appropriate because the Denver county-specific fuel and age distribution data are the same for all the counties in the Denver Metropolitan Area, which represents all counties in the project area.

## **Vehicles, Equipment, and Fuel Type**

The Vehicles/Equipment panel is used to specify the vehicle types that are included in the MOVES run. This PM<sub>10</sub> hotspot analysis includes all vehicle types that are expected to operate in the project area. This was accomplished by selecting all of the appropriate fuel and vehicle type combinations in the Vehicle/Equipment panel, which reflects the full range of vehicles that will operate in the project area.

The following vehicles were included:

- Motorcycle
- Passenger car
- Passenger truck
- Light commercial truck
- Refuse vehicle
- Motor home
- School bus
- Transit bus
- Intercity bus
- Single-unit long-haul truck
- Single-unit short-haul truck
- Combination long-haul truck
- Combination short-haul truck

### **Road Type**

The Road Type panel was used to define the types of roads that are included in the project. For this project, three road types were used:

- Urban Restricted Access: an urban highway that can be accessed only by an on ramp
- Urban Unrestricted Access: all other urban roads (arterials, connectors, and local streets)
- Off Network: for the Pilot Travel Center

The Road Type designation determines the driving cycle used for the given roadway. This considers stop-and-go activity, acceleration, deceleration, cruising, idling, and other driving behavior. For this analysis, the default driving cycles were used.

### **Pollutants and Processes**

The Pollutant and Processes panel was used to select both the types of pollutants and the emission processes that produce them. In completing this PM<sub>10</sub> hotspot analysis, MOVES calculates emissions for four separate processes:

- Running exhaust
- Crankcase running exhaust
- Brake wear
- Tire wear

The MOVES output is post-processed to calculate an aggregate emissions rate.

### **Manage Input Databases**

This input panel was not utilized for this analysis.

### **Strategies**

This input panel was not utilized for this analysis.

### **Output**

This input panel allows the user to specify how they would like the MOVES output to be formatted, including what data it should contain and in what units of measure. Under the General Output pathway, “grams” and “miles” were selected for the output units to provide emissions rates for air quality modeling. Also, “Distance Traveled” and “Population” were selected under the “Activity” heading to obtain vehicle volume information for each link in the output (i.e., to allow for the calculation of emissions rates in vehicle-grams per mile if desired). Under the “Output Emissions Detail” heading, the box labeled “Emission Process” was selected. This is necessary for post-processing the MOVES output since multiple

emissions processes are being modeled and MOVES does not automatically calculate an aggregate emissions rate.

**Advanced Performance Features**

This input panel was not utilized for this analysis.

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# **Attachment J – Appendix H**

## **MOVES Input Data Assumptions for the**

### **PM<sub>10</sub> Hotspot Analysis**



# Appendix H: Project Details/Input Database Tables

The input database tables that contain the project details are described in this appendix. These tables are imported into the MOVES model runs using the Project Data Manager.

## **Meteorology**

Local meteorology data were used for this analysis. Per MOVES guidance, within each period of the day of the quarter selected, temperatures were used that represent the five-year average within that time period. For example, the January morning peak periods correspond to 6:00 a.m. to 9:00 a.m. Thus, the average January temperature based on the meteorological record for those hours was used to estimate the average January morning peak period temperature for the MOVES runs.

## **Age Distribution**

The Age Distribution Importer was used to enter data that provides the distribution of vehicle fractions by age for each calendar year (yearID) and vehicle type (sourceTypeID). The distribution of the vehicle age fractions (ageID) must sum to one (1.00) for each vehicle type and year. For this analysis, the latest available local age distribution assumptions from the SIP were used. This age distribution was provided by APCD.

## **Fuel Supply and Formulation**

The Fuel Supply Importer and Fuel Formulation Importer were used to enter the necessary information describing fuel type and fuel mix for each respective MOVES run. Per EPA recommendation, the MOVES default fuel supply and formulation information were used for this analysis.

## **Inspection and Maintenance**

MOVES does not provide a PM<sub>10</sub> emission benefit from inspection/maintenance (I/M) programs. As such, no I/M file was imported for the PM<sub>10</sub> analysis.

## **Link Source Type**

The Link Source Type Importer defines the fraction of the link traffic volume that is represented by each vehicle type (source type). For this analysis, project-specific commercial traffic data were provided for each link from the DRCOG Compass model runs.

## **Links**

The Links Importer was used to define the individual roadway links. All links modeled were defined with unique IDs. Information on each link's length (in miles), traffic volume (units of vehicles per hour), average speed (miles per hour), and road grade (percent) were provided. To produce emission rates for a PM<sub>10</sub> hotspot analysis, users performing such an analysis should calculate emissions based on average speeds. The average speed defined for each link is internally matched with a MOVES default drive cycle based on that average speed, road grade, and road type and used to calculate emissions.

### **Describing Vehicle Activity**

MOVES determines vehicle emissions based on operating modes, which represent different types of vehicle activity such as acceleration (at different rates), deceleration, idle, and cruise conditions. These operating conditions have distinct emission rates. MOVES handles these data in the form of a distribution of the time vehicles spend in different operating modes. This capability is central to the use of MOVES for PM<sub>10</sub> hotspot analysis because it allows for the analysis of fine distinctions between vehicle behavior and emissions before and after construction of the project. For this analysis, the average speed and road type were provided through the Links input. Using this approach, MOVES calculates emissions based on a default drive cycle for a given speed, grade, and road type.

### **Off Network**

The Off-Network Importer is where information about the truck stop located at the northeast corner of I-70/46<sup>th</sup> Avenue and Vasquez Boulevard/Steele Street was imported.

## **Appendix H Supplement**

### **MOVES Input Data Assumptions**

**for the**

**.....PM-10 Hotspot Analysis**

## Temperature and Humidity

Month ID	Month	Zone ID	Hour	Temperature (degrees Fahrenheit)	Percent Relative Humidity
1	January	80310	1	31.55	55.09%
1	January	80310	2	31.81	53.22%
1	January	80310	3	32.74	55.05%
1	January	80310	4	32.00	55.87%
1	January	80310	5	32.16	56.73%
1	January	80310	6	31.84	55.40%
1	January	80310	7	30.40	53.67%
1	January	80310	8	30.90	51.54%
1	January	80310	9	33.76	45.89%
1	January	80310	10	36.48	42.44%
1	January	80310	11	38.97	40.44%
1	January	80310	12	40.34	38.81%
1	January	80310	13	41.29	36.62%
1	January	80310	14	41.93	38.00%
1	January	80310	15	41.92	41.46%
1	January	80310	16	39.38	39.67%
1	January	80310	17	38.44	44.63%
1	January	80310	18	37.67	50.58%
1	January	80310	19	36.26	46.81%
1	January	80310	20	34.63	50.79%
1	January	80310	21	33.31	51.30%
1	January	80310	22	32.32	50.67%
1	January	80310	23	31.80	52.08%

## Vehicle Age Distribution - 2010

Vehicle Age (relative to year)	Motorcycle	Passenger Car	Passenger Truck	Light Commercial Truck	Intercity Bus
	11	21	31	32	41
0	0.40%	2.04%	2.05%	1.90%	2.36%
1	1.94%	4.97%	4.36%	3.87%	0.67%
2	5.59%	4.43%	2.97%	3.06%	2.24%
3	6.87%	5.10%	6.04%	6.06%	6.29%
4	8.13%	5.51%	6.28%	6.27%	6.73%
5	7.09%	5.67%	6.08%	6.39%	12.68%
6	6.75%	5.72%	6.69%	6.66%	8.75%
7	5.58%	5.57%	7.00%	7.15%	5.95%
8	7.23%	5.83%	6.26%	6.45%	1.91%
9	5.96%	6.24%	6.70%	6.66%	1.80%
10	5.17%	5.98%	6.38%	6.50%	7.30%
11	4.35%	5.92%	6.18%	6.09%	27.61%
12	3.64%	5.10%	5.53%	5.59%	3.25%
13	2.74%	4.45%	4.41%	4.13%	5.39%
14	2.26%	4.10%	3.89%	3.99%	1.01%
15	2.02%	3.37%	2.95%	2.94%	0.11%
16	1.72%	3.24%	2.77%	2.84%	0.22%
17	1.38%	2.45%	2.32%	2.29%	0.45%
18	1.31%	2.13%	1.76%	1.73%	0.34%
19	1.03%	1.80%	1.27%	1.31%	0.56%
20	0.81%	1.57%	1.13%	1.11%	0.56%
21	0.79%	1.27%	0.94%	0.96%	0.11%
22	0.81%	0.88%	0.83%	0.89%	0.45%
23	0.70%	0.68%	0.68%	0.68%	0.00%
24	0.81%	0.54%	0.49%	0.49%	0.00%
25	1.24%	0.43%	0.45%	0.48%	0.67%
26	1.21%	0.32%	0.36%	0.39%	0.11%
27	0.96%	0.26%	0.30%	0.35%	0.22%
28	1.24%	0.16%	0.18%	0.19%	0.34%
29	1.76%	0.12%	0.14%	0.18%	0.22%
30+	8.50%	4.14%	2.62%	2.40%	1.68%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distribution - 2010

Vehicle Age (relative to year)	Transit Bus	School Bus	Refuse Truck	Single Unit Short- haul Truck	Single Unit Long- haul Truck
	42	43	51	52	53
0	2.66%	2.80%	2.50%	1.18%	1.16%
1	0.89%	2.92%	1.88%	2.78%	2.32%
2	2.31%	4.83%	4.38%	6.04%	6.63%
3	5.68%	9.27%	3.75%	4.27%	3.32%
4	5.86%	7.84%	6.88%	9.27%	7.96%
5	13.14%	8.75%	6.88%	7.32%	7.13%
6	7.28%	5.41%	4.38%	7.37%	7.79%
7	5.68%	8.45%	4.38%	5.80%	4.98%
8	1.24%	4.74%	4.38%	4.44%	4.31%
9	2.13%	4.89%	4.38%	4.11%	6.14%
10	7.64%	5.17%	5.63%	4.91%	5.47%
11	27.53%	5.96%	11.25%	7.11%	8.13%
12	2.13%	3.34%	9.38%	6.45%	6.80%
13	5.51%	3.95%	4.38%	4.30%	4.81%
14	0.53%	3.89%	1.88%	3.25%	3.81%
15	1.07%	1.22%	4.38%	2.47%	1.00%
16	0.71%	2.22%	4.38%	3.66%	4.48%
17	1.07%	1.52%	3.13%	1.97%	1.33%
18	1.07%	1.31%	3.75%	1.82%	2.82%
19	0.89%	1.22%	0.63%	1.51%	1.49%
20	0.00%	1.09%	1.88%	1.71%	1.49%
21	0.71%	2.58%	0.63%	1.62%	1.16%
22	0.89%	1.12%	0.00%	1.08%	1.16%
23	0.36%	0.70%	0.00%	1.01%	0.66%
24	0.18%	0.73%	0.00%	0.95%	0.66%
25	0.18%	1.19%	1.25%	0.88%	0.33%
26	0.00%	0.33%	1.25%	0.73%	1.16%
27	0.00%	0.18%	0.63%	0.56%	0.66%
28	0.71%	0.18%	0.00%	0.26%	0.00%
29	0.36%	0.61%	0.63%	0.53%	0.50%
30+	1.60%	1.58%	1.25%	0.67%	0.33%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distribution - 2010

Vehicle Age (relative to year)	Motor Home	Combination Short-haul Truck	Combination Long-haul Truck
	54	61	62
0	1.33%	1.48%	1.46%
1	2.67%	2.75%	2.04%
2	5.94%	4.27%	2.51%
3	5.45%	4.07%	3.55%
4	8.85%	8.62%	7.87%
5	7.88%	5.99%	5.30%
6	5.45%	7.31%	6.47%
7	8.00%	4.87%	4.02%
8	5.70%	3.87%	5.48%
9	3.64%	3.63%	3.90%
10	3.76%	4.71%	5.77%
11	6.18%	7.86%	8.97%
12	6.42%	5.75%	7.40%
13	3.76%	4.15%	4.08%
14	3.03%	3.75%	4.37%
15	1.82%	3.31%	3.96%
16	3.52%	4.63%	4.20%
17	1.58%	2.91%	3.32%
18	1.70%	2.79%	3.32%
19	1.21%	1.76%	1.92%
20	2.79%	2.12%	1.28%
21	1.45%	1.68%	1.34%
22	0.00%	1.40%	1.40%
23	1.70%	0.88%	1.40%
24	1.70%	0.88%	0.82%
25	0.73%	1.24%	0.93%
26	0.85%	1.04%	1.11%
27	0.73%	0.56%	0.41%
28	0.48%	0.52%	0.17%
29	0.61%	0.12%	0.52%
30+	1.09%	1.08%	0.70%
Total	100.00%	100.00%	100.00%

## Vehicle Age Distributions - 2035

ageID	Motorcycle	Passenger Car	Passenger Truck	Light Commercial Truck	Intercity Bus
	11	21	31	32	41
0	0.40%	2.04%	2.05%	1.90%	2.36%
1	1.94%	4.97%	4.36%	3.87%	0.67%
2	5.59%	4.43%	2.97%	3.06%	2.24%
3	6.87%	5.10%	6.04%	6.06%	6.29%
4	8.13%	5.51%	6.28%	6.27%	6.73%
5	7.09%	5.67%	6.08%	6.39%	12.68%
6	6.75%	5.72%	6.69%	6.66%	8.75%
7	5.58%	5.57%	7.00%	7.15%	5.95%
8	7.23%	5.83%	6.26%	6.45%	1.91%
9	5.96%	6.24%	6.70%	6.66%	1.80%
10	5.17%	5.98%	6.38%	6.50%	7.30%
11	4.35%	5.92%	6.18%	6.09%	27.61%
12	3.64%	5.10%	5.53%	5.59%	3.25%
13	2.74%	4.45%	4.41%	4.13%	5.39%
14	2.26%	4.10%	3.89%	3.99%	1.01%
15	2.02%	3.37%	2.95%	2.94%	0.11%
16	1.72%	3.24%	2.77%	2.84%	0.22%
17	1.38%	2.45%	2.32%	2.29%	0.45%
18	1.31%	2.13%	1.76%	1.73%	0.34%
19	1.03%	1.80%	1.27%	1.31%	0.56%
20	0.81%	1.57%	1.13%	1.11%	0.56%
21	0.79%	1.27%	0.94%	0.96%	0.11%
22	0.81%	0.88%	0.83%	0.89%	0.45%
23	0.70%	0.68%	0.68%	0.68%	0.00%
24	0.81%	0.54%	0.49%	0.49%	0.00%
25	1.24%	0.43%	0.45%	0.48%	0.67%
26	1.21%	0.32%	0.36%	0.39%	0.11%
27	0.96%	0.26%	0.30%	0.35%	0.22%
28	1.24%	0.16%	0.18%	0.19%	0.34%
29	1.76%	0.12%	0.14%	0.18%	0.22%
30+	8.50%	4.14%	2.62%	2.40%	1.68%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distributions - 2035

ageID	Transit Bus	School Bus	Refuse Truck	Single Unit Short-haul Truck	Single Unit Long- haul Truck
	42	43	51	52	53
0	2.66%	2.80%	2.50%	1.18%	1.16%
1	0.89%	2.92%	1.88%	2.78%	2.32%
2	2.31%	4.83%	4.38%	6.04%	6.63%
3	5.68%	9.27%	3.75%	4.27%	3.32%
4	5.86%	7.84%	6.88%	9.27%	7.96%
5	13.14%	8.75%	6.88%	7.32%	7.13%
6	7.28%	5.41%	4.38%	7.37%	7.79%
7	5.68%	8.45%	4.38%	5.80%	4.98%
8	1.24%	4.74%	4.38%	4.44%	4.31%
9	2.13%	4.89%	4.38%	4.11%	6.14%
10	7.64%	5.17%	5.63%	4.91%	5.47%
11	27.53%	5.96%	11.25%	7.11%	8.13%
12	2.13%	3.34%	9.38%	6.45%	6.80%
13	5.51%	3.95%	4.38%	4.30%	4.81%
14	0.53%	3.89%	1.88%	3.25%	3.81%
15	1.07%	1.22%	4.38%	2.47%	1.00%
16	0.71%	2.22%	4.38%	3.66%	4.48%
17	1.07%	1.52%	3.13%	1.97%	1.33%
18	1.07%	1.31%	3.75%	1.82%	2.82%
19	0.89%	1.22%	0.63%	1.51%	1.49%
20	0.00%	1.09%	1.88%	1.71%	1.49%
21	0.71%	2.58%	0.63%	1.62%	1.16%
22	0.89%	1.12%	0.00%	1.08%	1.16%
23	0.36%	0.70%	0.00%	1.01%	0.66%
24	0.18%	0.73%	0.00%	0.95%	0.66%
25	0.18%	1.19%	1.25%	0.88%	0.33%
26	0.00%	0.33%	1.25%	0.73%	1.16%
27	0.00%	0.18%	0.63%	0.56%	0.66%
28	0.71%	0.18%	0.00%	0.26%	0.00%
29	0.36%	0.61%	0.63%	0.53%	0.50%
30+	1.60%	1.58%	1.25%	0.67%	0.33%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distributions - 2035

ageID	Motor Home	Combination Short-haul Truck	Combination Long-haul Truck
	54	61	62
0	1.33%	1.48%	1.46%
1	2.67%	2.75%	2.04%
2	5.94%	4.27%	2.51%
3	5.45%	4.07%	3.55%
4	8.85%	8.62%	7.87%
5	7.88%	5.99%	5.30%
6	5.45%	7.31%	6.47%
7	8.00%	4.87%	4.02%
8	5.70%	3.87%	5.48%
9	3.64%	3.63%	3.90%
10	3.76%	4.71%	5.77%
11	6.18%	7.86%	8.97%
12	6.42%	5.75%	7.40%
13	3.76%	4.15%	4.08%
14	3.03%	3.75%	4.37%
15	1.82%	3.31%	3.96%
16	3.52%	4.63%	4.20%
17	1.58%	2.91%	3.32%
18	1.70%	2.79%	3.32%
19	1.21%	1.76%	1.92%
20	2.79%	2.12%	1.28%
21	1.45%	1.68%	1.34%
22	0.00%	1.40%	1.40%
23	1.70%	0.88%	1.40%
24	1.70%	0.88%	0.82%
25	0.73%	1.24%	0.93%
26	0.85%	1.04%	1.11%
27	0.73%	0.56%	0.41%
28	0.48%	0.52%	0.17%
29	0.61%	0.12%	0.52%
30+	1.09%	1.08%	0.70%
Total	100.00%	100.00%	100.00%

## Inspection and Maintenance Program Parameters

pol Process ID	state ID	county ID	year ID	source Type ID	fuel Type ID	IM Program ID	inspect Freq	test Standards ID	beg Model Year ID	end Model Year ID	use IMyn	compliance Factor
201	8	8031	2035	21	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	21	1	6	2	33	1982	2033	Y	93.12
201	8	8031	2035	31	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	31	1	6	2	33	1982	2033	Y	93.12
201	8	8031	2035	32	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	32	1	6	2	33	1982	2033	Y	93.12
201	8	8031	2035	52	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	52	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	21	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	21	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	31	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	31	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	32	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	32	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	52	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	52	1	6	2	33	1982	2033	Y	93.12

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# **Attachment J – Appendix I**

## **Input Data Assumptions for Emission Inventories**



## Temperature and Humidity

Month ID	Month	Zone ID	Hour	Temperature (degrees Fahrenheit)	Percent Relative Humidity
1	January	80310	1	31.55	55.09%
1	January	80310	2	31.81	53.22%
1	January	80310	3	32.74	55.05%
1	January	80310	4	32.00	55.87%
1	January	80310	5	32.16	56.73%
1	January	80310	6	31.84	55.40%
1	January	80310	7	30.40	53.67%
1	January	80310	8	30.90	51.54%
1	January	80310	9	33.76	45.89%
1	January	80310	10	36.48	42.44%
1	January	80310	11	38.97	40.44%
1	January	80310	12	40.34	38.81%
1	January	80310	13	41.29	36.62%
1	January	80310	14	41.93	38.00%
1	January	80310	15	41.92	41.46%
1	January	80310	16	39.38	39.67%
1	January	80310	17	38.44	44.63%
1	January	80310	18	37.67	50.58%
1	January	80310	19	36.26	46.81%
1	January	80310	20	34.63	50.79%
1	January	80310	21	33.31	51.30%
1	January	80310	22	32.32	50.67%
1	January	80310	23	31.80	52.08%

## Vehicle Age Distribution - 2010

Vehicle Age (relative to year)	Motorcycle	Passenger Car	Passenger Truck	Light Commercial Truck	Intercity Bus
	11	21	31	32	41
0	0.40%	2.04%	2.05%	1.90%	2.36%
1	1.94%	4.97%	4.36%	3.87%	0.67%
2	5.59%	4.43%	2.97%	3.06%	2.24%
3	6.87%	5.10%	6.04%	6.06%	6.29%
4	8.13%	5.51%	6.28%	6.27%	6.73%
5	7.09%	5.67%	6.08%	6.39%	12.68%
6	6.75%	5.72%	6.69%	6.66%	8.75%
7	5.58%	5.57%	7.00%	7.15%	5.95%
8	7.23%	5.83%	6.26%	6.45%	1.91%
9	5.96%	6.24%	6.70%	6.66%	1.80%
10	5.17%	5.98%	6.38%	6.50%	7.30%
11	4.35%	5.92%	6.18%	6.09%	27.61%
12	3.64%	5.10%	5.53%	5.59%	3.25%
13	2.74%	4.45%	4.41%	4.13%	5.39%
14	2.26%	4.10%	3.89%	3.99%	1.01%
15	2.02%	3.37%	2.95%	2.94%	0.11%
16	1.72%	3.24%	2.77%	2.84%	0.22%
17	1.38%	2.45%	2.32%	2.29%	0.45%
18	1.31%	2.13%	1.76%	1.73%	0.34%
19	1.03%	1.80%	1.27%	1.31%	0.56%
20	0.81%	1.57%	1.13%	1.11%	0.56%
21	0.79%	1.27%	0.94%	0.96%	0.11%
22	0.81%	0.88%	0.83%	0.89%	0.45%
23	0.70%	0.68%	0.68%	0.68%	0.00%
24	0.81%	0.54%	0.49%	0.49%	0.00%
25	1.24%	0.43%	0.45%	0.48%	0.67%
26	1.21%	0.32%	0.36%	0.39%	0.11%
27	0.96%	0.26%	0.30%	0.35%	0.22%
28	1.24%	0.16%	0.18%	0.19%	0.34%
29	1.76%	0.12%	0.14%	0.18%	0.22%
30+	8.50%	4.14%	2.62%	2.40%	1.68%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distribution - 2010

Vehicle Age (relative to year)	Transit Bus	School Bus	Refuse Truck	Single Unit Short- haul Truck	Single Unit Long- haul Truck
	42	43	51	52	53
0	2.66%	2.80%	2.50%	1.18%	1.16%
1	0.89%	2.92%	1.88%	2.78%	2.32%
2	2.31%	4.83%	4.38%	6.04%	6.63%
3	5.68%	9.27%	3.75%	4.27%	3.32%
4	5.86%	7.84%	6.88%	9.27%	7.96%
5	13.14%	8.75%	6.88%	7.32%	7.13%
6	7.28%	5.41%	4.38%	7.37%	7.79%
7	5.68%	8.45%	4.38%	5.80%	4.98%
8	1.24%	4.74%	4.38%	4.44%	4.31%
9	2.13%	4.89%	4.38%	4.11%	6.14%
10	7.64%	5.17%	5.63%	4.91%	5.47%
11	27.53%	5.96%	11.25%	7.11%	8.13%
12	2.13%	3.34%	9.38%	6.45%	6.80%
13	5.51%	3.95%	4.38%	4.30%	4.81%
14	0.53%	3.89%	1.88%	3.25%	3.81%
15	1.07%	1.22%	4.38%	2.47%	1.00%
16	0.71%	2.22%	4.38%	3.66%	4.48%
17	1.07%	1.52%	3.13%	1.97%	1.33%
18	1.07%	1.31%	3.75%	1.82%	2.82%
19	0.89%	1.22%	0.63%	1.51%	1.49%
20	0.00%	1.09%	1.88%	1.71%	1.49%
21	0.71%	2.58%	0.63%	1.62%	1.16%
22	0.89%	1.12%	0.00%	1.08%	1.16%
23	0.36%	0.70%	0.00%	1.01%	0.66%
24	0.18%	0.73%	0.00%	0.95%	0.66%
25	0.18%	1.19%	1.25%	0.88%	0.33%
26	0.00%	0.33%	1.25%	0.73%	1.16%
27	0.00%	0.18%	0.63%	0.56%	0.66%
28	0.71%	0.18%	0.00%	0.26%	0.00%
29	0.36%	0.61%	0.63%	0.53%	0.50%
30+	1.60%	1.58%	1.25%	0.67%	0.33%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distribution - 2010

Vehicle Age (relative to year)	Motor Home	Combination Short-haul Truck	Combination Long-haul Truck
	54	61	62
0	1.33%	1.48%	1.46%
1	2.67%	2.75%	2.04%
2	5.94%	4.27%	2.51%
3	5.45%	4.07%	3.55%
4	8.85%	8.62%	7.87%
5	7.88%	5.99%	5.30%
6	5.45%	7.31%	6.47%
7	8.00%	4.87%	4.02%
8	5.70%	3.87%	5.48%
9	3.64%	3.63%	3.90%
10	3.76%	4.71%	5.77%
11	6.18%	7.86%	8.97%
12	6.42%	5.75%	7.40%
13	3.76%	4.15%	4.08%
14	3.03%	3.75%	4.37%
15	1.82%	3.31%	3.96%
16	3.52%	4.63%	4.20%
17	1.58%	2.91%	3.32%
18	1.70%	2.79%	3.32%
19	1.21%	1.76%	1.92%
20	2.79%	2.12%	1.28%
21	1.45%	1.68%	1.34%
22	0.00%	1.40%	1.40%
23	1.70%	0.88%	1.40%
24	1.70%	0.88%	0.82%
25	0.73%	1.24%	0.93%
26	0.85%	1.04%	1.11%
27	0.73%	0.56%	0.41%
28	0.48%	0.52%	0.17%
29	0.61%	0.12%	0.52%
30+	1.09%	1.08%	0.70%
Total	100.00%	100.00%	100.00%

## Vehicle Age Distributions - 2035

ageID	Motorcycle	Passenger Car	Passenger Truck	Light Commercial Truck	Intercity Bus
	11	21	31	32	41
0	0.40%	2.04%	2.05%	1.90%	2.36%
1	1.94%	4.97%	4.36%	3.87%	0.67%
2	5.59%	4.43%	2.97%	3.06%	2.24%
3	6.87%	5.10%	6.04%	6.06%	6.29%
4	8.13%	5.51%	6.28%	6.27%	6.73%
5	7.09%	5.67%	6.08%	6.39%	12.68%
6	6.75%	5.72%	6.69%	6.66%	8.75%
7	5.58%	5.57%	7.00%	7.15%	5.95%
8	7.23%	5.83%	6.26%	6.45%	1.91%
9	5.96%	6.24%	6.70%	6.66%	1.80%
10	5.17%	5.98%	6.38%	6.50%	7.30%
11	4.35%	5.92%	6.18%	6.09%	27.61%
12	3.64%	5.10%	5.53%	5.59%	3.25%
13	2.74%	4.45%	4.41%	4.13%	5.39%
14	2.26%	4.10%	3.89%	3.99%	1.01%
15	2.02%	3.37%	2.95%	2.94%	0.11%
16	1.72%	3.24%	2.77%	2.84%	0.22%
17	1.38%	2.45%	2.32%	2.29%	0.45%
18	1.31%	2.13%	1.76%	1.73%	0.34%
19	1.03%	1.80%	1.27%	1.31%	0.56%
20	0.81%	1.57%	1.13%	1.11%	0.56%
21	0.79%	1.27%	0.94%	0.96%	0.11%
22	0.81%	0.88%	0.83%	0.89%	0.45%
23	0.70%	0.68%	0.68%	0.68%	0.00%
24	0.81%	0.54%	0.49%	0.49%	0.00%
25	1.24%	0.43%	0.45%	0.48%	0.67%
26	1.21%	0.32%	0.36%	0.39%	0.11%
27	0.96%	0.26%	0.30%	0.35%	0.22%
28	1.24%	0.16%	0.18%	0.19%	0.34%
29	1.76%	0.12%	0.14%	0.18%	0.22%
30+	8.50%	4.14%	2.62%	2.40%	1.68%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distributions - 2035

ageID	Transit Bus	School Bus	Refuse Truck	Single Unit Short-haul Truck	Single Unit Long- haul Truck
	42	43	51	52	53
0	2.66%	2.80%	2.50%	1.18%	1.16%
1	0.89%	2.92%	1.88%	2.78%	2.32%
2	2.31%	4.83%	4.38%	6.04%	6.63%
3	5.68%	9.27%	3.75%	4.27%	3.32%
4	5.86%	7.84%	6.88%	9.27%	7.96%
5	13.14%	8.75%	6.88%	7.32%	7.13%
6	7.28%	5.41%	4.38%	7.37%	7.79%
7	5.68%	8.45%	4.38%	5.80%	4.98%
8	1.24%	4.74%	4.38%	4.44%	4.31%
9	2.13%	4.89%	4.38%	4.11%	6.14%
10	7.64%	5.17%	5.63%	4.91%	5.47%
11	27.53%	5.96%	11.25%	7.11%	8.13%
12	2.13%	3.34%	9.38%	6.45%	6.80%
13	5.51%	3.95%	4.38%	4.30%	4.81%
14	0.53%	3.89%	1.88%	3.25%	3.81%
15	1.07%	1.22%	4.38%	2.47%	1.00%
16	0.71%	2.22%	4.38%	3.66%	4.48%
17	1.07%	1.52%	3.13%	1.97%	1.33%
18	1.07%	1.31%	3.75%	1.82%	2.82%
19	0.89%	1.22%	0.63%	1.51%	1.49%
20	0.00%	1.09%	1.88%	1.71%	1.49%
21	0.71%	2.58%	0.63%	1.62%	1.16%
22	0.89%	1.12%	0.00%	1.08%	1.16%
23	0.36%	0.70%	0.00%	1.01%	0.66%
24	0.18%	0.73%	0.00%	0.95%	0.66%
25	0.18%	1.19%	1.25%	0.88%	0.33%
26	0.00%	0.33%	1.25%	0.73%	1.16%
27	0.00%	0.18%	0.63%	0.56%	0.66%
28	0.71%	0.18%	0.00%	0.26%	0.00%
29	0.36%	0.61%	0.63%	0.53%	0.50%
30+	1.60%	1.58%	1.25%	0.67%	0.33%
Total	100.00%	100.00%	100.00%	100.00%	100.00%

## Vehicle Age Distributions - 2035

ageID	Motor Home	Combination Short-haul Truck	Combination Long-haul Truck
	54	61	62
0	1.33%	1.48%	1.46%
1	2.67%	2.75%	2.04%
2	5.94%	4.27%	2.51%
3	5.45%	4.07%	3.55%
4	8.85%	8.62%	7.87%
5	7.88%	5.99%	5.30%
6	5.45%	7.31%	6.47%
7	8.00%	4.87%	4.02%
8	5.70%	3.87%	5.48%
9	3.64%	3.63%	3.90%
10	3.76%	4.71%	5.77%
11	6.18%	7.86%	8.97%
12	6.42%	5.75%	7.40%
13	3.76%	4.15%	4.08%
14	3.03%	3.75%	4.37%
15	1.82%	3.31%	3.96%
16	3.52%	4.63%	4.20%
17	1.58%	2.91%	3.32%
18	1.70%	2.79%	3.32%
19	1.21%	1.76%	1.92%
20	2.79%	2.12%	1.28%
21	1.45%	1.68%	1.34%
22	0.00%	1.40%	1.40%
23	1.70%	0.88%	1.40%
24	1.70%	0.88%	0.82%
25	0.73%	1.24%	0.93%
26	0.85%	1.04%	1.11%
27	0.73%	0.56%	0.41%
28	0.48%	0.52%	0.17%
29	0.61%	0.12%	0.52%
30+	1.09%	1.08%	0.70%
Total	100.00%	100.00%	100.00%

## Inspection and Maintenance Program Parameters

pol Process ID	state ID	county ID	year ID	source Type ID	fuel Type ID	IM Program ID	inspect Freq	test Standards ID	beg Model Year ID	end Model Year ID	use IMyn	compliance Factor
201	8	8031	2035	21	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	21	1	6	2	33	1982	2033	Y	93.12
201	8	8031	2035	31	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	31	1	6	2	33	1982	2033	Y	93.12
201	8	8031	2035	32	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	32	1	6	2	33	1982	2033	Y	93.12
201	8	8031	2035	52	1	1	1	11	1968	1981	Y	93.12
201	8	8031	2035	52	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	21	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	21	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	31	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	31	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	32	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	32	1	6	2	33	1982	2033	Y	93.12
202	8	8031	2035	52	1	1	1	11	1968	1981	Y	93.12
202	8	8031	2035	52	1	6	2	33	1982	2033	Y	93.12

## Speed Bin Distribution - Study Area - 2010

Hour	Road Type	Average Speed Bin	VMT Distribution (all vehicle types)
00:00-23:59	Freeway	1	
00:00-23:59	Freeway	2	-
00:00-23:59	Freeway	3	-
00:00-23:59	Freeway	4	-
00:00-23:59	Freeway	5	-
00:00-23:59	Freeway	6	-
00:00-23:59	Freeway	7	-
00:00-23:59	Freeway	8	-
00:00-23:59	Freeway	9	0.0612
00:00-23:59	Freeway	10	0.0099
00:00-23:59	Freeway	11	0.1048
00:00-23:59	Freeway	12	0.2183
00:00-23:59	Freeway	13	0.3382
00:00-23:59	Freeway	14	0.2298
00:00-23:59	Freeway	15	-
00:00-23:59	Freeway	16	0.0378
00:00-23:59	Non-freeway	1	-
00:00-23:59	Non-freeway	2	0.0003
00:00-23:59	Non-freeway	3	0.0042
00:00-23:59	Non-freeway	4	0.0682
00:00-23:59	Non-freeway	5	0.0932
00:00-23:59	Non-freeway	6	0.1045
00:00-23:59	Non-freeway	7	0.1830
00:00-23:59	Non-freeway	8	0.3296
00:00-23:59	Non-freeway	9	0.1606
00:00-23:59	Non-freeway	10	0.0183
00:00-23:59	Non-freeway	11	0.0305
00:00-23:59	Non-freeway	12	-
00:00-23:59	Non-freeway	13	0.0074
00:00-23:59	Non-freeway	14	-
00:00-23:59	Non-freeway	15	-
00:00-23:59	Non-freeway	16	-

## Speed Bin Distribution - Study Area - 2015

Hour	Road Type	Average Speed Bin	VMT Distribution (all vehicle types)
00:00-23:59	Freeway	1	-
00:00-23:59	Freeway	2	-
00:00-23:59	Freeway	3	-
00:00-23:59	Freeway	4	-
00:00-23:59	Freeway	5	-
00:00-23:59	Freeway	6	-
00:00-23:59	Freeway	7	-
00:00-23:59	Freeway	8	0.0524
00:00-23:59	Freeway	9	0.0097
00:00-23:59	Freeway	10	0.0541
00:00-23:59	Freeway	11	0.1562
00:00-23:59	Freeway	12	0.1199
00:00-23:59	Freeway	13	0.4080
00:00-23:59	Freeway	14	0.1623
00:00-23:59	Freeway	15	0.0299
00:00-23:59	Freeway	16	0.0074
00:00-23:59	Non-freeway	1	-
00:00-23:59	Non-freeway	2	0.0006
00:00-23:59	Non-freeway	3	0.0006
00:00-23:59	Non-freeway	4	0.0715
00:00-23:59	Non-freeway	5	0.0910
00:00-23:59	Non-freeway	6	0.0990
00:00-23:59	Non-freeway	7	0.1568
00:00-23:59	Non-freeway	8	0.3564
00:00-23:59	Non-freeway	9	0.1612
00:00-23:59	Non-freeway	10	0.0156
00:00-23:59	Non-freeway	11	0.0238
00:00-23:59	Non-freeway	12	0.0062
00:00-23:59	Non-freeway	13	0.0173
00:00-23:59	Non-freeway	14	-
00:00-23:59	Non-freeway	15	-
00:00-23:59	Non-freeway	16	-

## Speed Bin Distribution - Study Area - 2020

Hour	Road Type	Average Speed Bin	VMT Distribution (all vehicle types)
00:00-23:59	Freeway	1	-
00:00-23:59	Freeway	2	-
00:00-23:59	Freeway	3	-
00:00-23:59	Freeway	4	-
00:00-23:59	Freeway	5	-
00:00-23:59	Freeway	6	-
00:00-23:59	Freeway	7	0.0292
00:00-23:59	Freeway	8	0.0340
00:00-23:59	Freeway	9	0.0405
00:00-23:59	Freeway	10	0.0717
00:00-23:59	Freeway	11	0.1450
00:00-23:59	Freeway	12	0.1812
00:00-23:59	Freeway	13	0.2948
00:00-23:59	Freeway	14	0.1681
00:00-23:59	Freeway	15	0.0150
00:00-23:59	Freeway	16	0.0205
00:00-23:59	Non-freeway	1	-
00:00-23:59	Non-freeway	2	0.0005
00:00-23:59	Non-freeway	3	0.0024
00:00-23:59	Non-freeway	4	0.0759
00:00-23:59	Non-freeway	5	0.1001
00:00-23:59	Non-freeway	6	0.1122
00:00-23:59	Non-freeway	7	0.1663
00:00-23:59	Non-freeway	8	0.3315
00:00-23:59	Non-freeway	9	0.1603
00:00-23:59	Non-freeway	10	0.0126
00:00-23:59	Non-freeway	11	0.0199
00:00-23:59	Non-freeway	12	0.0045
00:00-23:59	Non-freeway	13	0.0137
00:00-23:59	Non-freeway	14	-
00:00-23:59	Non-freeway	15	-
00:00-23:59	Non-freeway	16	-

## Speed Bin Distribution - Study Area - 2025

Hour	Road Type	Average Speed Bin	VMT Distribution (all vehicle types)
00:00-23:59	Freeway	1	-
00:00-23:59	Freeway	2	-
00:00-23:59	Freeway	3	-
00:00-23:59	Freeway	4	-
00:00-23:59	Freeway	5	-
00:00-23:59	Freeway	6	-
00:00-23:59	Freeway	7	0.0585
00:00-23:59	Freeway	8	0.0155
00:00-23:59	Freeway	9	0.0712
00:00-23:59	Freeway	10	0.0893
00:00-23:59	Freeway	11	0.1338
00:00-23:59	Freeway	12	0.2425
00:00-23:59	Freeway	13	0.1817
00:00-23:59	Freeway	14	0.1739
00:00-23:59	Freeway	15	-
00:00-23:59	Freeway	16	0.0336
00:00-23:59	Non-freeway	1	-
00:00-23:59	Non-freeway	2	0.0005
00:00-23:59	Non-freeway	3	0.0041
00:00-23:59	Non-freeway	4	0.0804
00:00-23:59	Non-freeway	5	0.1091
00:00-23:59	Non-freeway	6	0.1254
00:00-23:59	Non-freeway	7	0.1759
00:00-23:59	Non-freeway	8	0.3067
00:00-23:59	Non-freeway	9	0.1594
00:00-23:59	Non-freeway	10	0.0095
00:00-23:59	Non-freeway	11	0.0160
00:00-23:59	Non-freeway	12	0.0029
00:00-23:59	Non-freeway	13	0.0101
00:00-23:59	Non-freeway	14	-
00:00-23:59	Non-freeway	15	-
00:00-23:59	Non-freeway	16	-

## Speed Bin Distribution - Study Area - 2030

Hour	Road Type	Average Speed Bin	VMT Distribution (all vehicle types)
00:00-23:59	Freeway	1	-
00:00-23:59	Freeway	2	-
00:00-23:59	Freeway	3	-
00:00-23:59	Freeway	4	-
00:00-23:59	Freeway	5	-
00:00-23:59	Freeway	6	0.0235
00:00-23:59	Freeway	7	0.0428
00:00-23:59	Freeway	8	0.0212
00:00-23:59	Freeway	9	0.0559
00:00-23:59	Freeway	10	0.1056
00:00-23:59	Freeway	11	0.1400
00:00-23:59	Freeway	12	0.2324
00:00-23:59	Freeway	13	0.1912
00:00-23:59	Freeway	14	0.1524
00:00-23:59	Freeway	15	-
00:00-23:59	Freeway	16	0.0351
00:00-23:59	Non-freeway	1	-
00:00-23:59	Non-freeway	2	0.0005
00:00-23:59	Non-freeway	3	0.0055
00:00-23:59	Non-freeway	4	0.0863
00:00-23:59	Non-freeway	5	0.1136
00:00-23:59	Non-freeway	6	0.1371
00:00-23:59	Non-freeway	7	0.1864
00:00-23:59	Non-freeway	8	0.2971
00:00-23:59	Non-freeway	9	0.1359
00:00-23:59	Non-freeway	10	0.0093
00:00-23:59	Non-freeway	11	0.0154
00:00-23:59	Non-freeway	12	0.0041
00:00-23:59	Non-freeway	13	0.0088
00:00-23:59	Non-freeway	14	-
00:00-23:59	Non-freeway	15	-
00:00-23:59	Non-freeway	16	-

## Speed Bin Distribution - Study Area - 2035

Hour	Road Type	Average Speed Bin	VMT Distribution (all vehicle types)
00:00-23:59	Freeway	1	-
00:00-23:59	Freeway	2	-
00:00-23:59	Freeway	3	-
00:00-23:59	Freeway	4	-
00:00-23:59	Freeway	5	-
00:00-23:59	Freeway	6	0.0471
00:00-23:59	Freeway	7	0.0271
00:00-23:59	Freeway	8	0.0268
00:00-23:59	Freeway	9	0.0405
00:00-23:59	Freeway	10	0.1219
00:00-23:59	Freeway	11	0.1463
00:00-23:59	Freeway	12	0.2222
00:00-23:59	Freeway	13	0.2006
00:00-23:59	Freeway	14	0.1309
00:00-23:59	Freeway	15	-
00:00-23:59	Freeway	16	0.0365
00:00-23:59	Non-freeway	1	-
00:00-23:59	Non-freeway	2	0.0005
00:00-23:59	Non-freeway	3	0.0070
00:00-23:59	Non-freeway	4	0.0921
00:00-23:59	Non-freeway	5	0.1182
00:00-23:59	Non-freeway	6	0.1488
00:00-23:59	Non-freeway	7	0.1969
00:00-23:59	Non-freeway	8	0.2875
00:00-23:59	Non-freeway	9	0.1124
00:00-23:59	Non-freeway	10	0.0091
00:00-23:59	Non-freeway	11	0.0149
00:00-23:59	Non-freeway	12	0.0053
00:00-23:59	Non-freeway	13	0.0075
00:00-23:59	Non-freeway	14	-
00:00-23:59	Non-freeway	15	-
00:00-23:59	Non-freeway	16	-

# **Attachment J – Appendix J**

## **Air Pollution Health Effects Literature Review**



# Air Pollution Health Effects Literature Review

Additional studies considering human health effects were reviewed during the documentation of health conditions for the study area. Some of the reports summarized below have been brought to the attention of FHWA by members of the public. FHWA's listing of these studies does not infer any endorsement, nor does it include any conclusions regarding the accuracy or applicability of these studies.

## ***Good Neighbor Study (City and County of Denver Department of Environmental Health 2014)***

The SDEIS includes an expanded discussion of the findings of the Good Neighbor study in consultation with the City and County of Denver Department of Environmental Health (DEH). DEH has recalculated the emissions using current air pollution modeling standards for evaluating MSATs.

## ***America's Children and the Environment (EPA 2013)***

In January of 2013, the EPA published the third edition of a report on health conditions for American children. This report notes progress made in reducing air pollution through increased regulatory control of particulate matter, sulfur dioxide, and nitrogen dioxide. These pollutants are known to aggravate asthma and are associated with other respiratory symptoms. The EPA report, however, notes the correlation between poor health conditions for children living near busy roadways.

## ***Status of Research on Potential Mitigation Concepts to Reduce Exposure to Nearby Traffic Pollution (Air Resources Board of California Environmental Protection 2012)***

In the *Status of Research on Potential Mitigation Concepts to Reduce Exposure to nearby Traffic Pollution*, the Air Resources Board of California Environmental Protection reports that populations living within 500 feet of busy roadways are highly prone to pollutants associated with vehicular traffic. They also reported that among residents living nearby to roadways, children are more vulnerable to adverse health effects of traffic emissions because they tend to spend a larger amount of time outside and have higher breathing rates per unit of body mass relative to adults.

## ***Urban air toxics concentration in Denver, May 2002 through April 2003. (CDPHE 2006)***

In this 2006 report, CDPHE linked occurrences of cancer to airborne pollutants exhibited at air monitoring stations near I-70 East in May 2002 to April 2003. Although none of the pollutants and the pollutant concentrations were unique to Denver, total cancer risks were found to range from 100 to 200 excess cancers per 1 million people. This range slightly exceeds the U.S. Environmental Protection Agency's proposed "acceptable" health risk for carcinogens. The report also concluded that there were little to no known non-cancer health risks associated with the pollutants exhibited in the area.

### ***Air Quality in Southern California – Time for a Paradigm Shift (Winer 2004)***

Arthur M. Winer, an Environmental Health Professor at UCLA's School of Public Health, has done extensive research on the subject of near-roadway air pollution. He has reported that poor health conditions exist in close proximity to heavy traffic corridors, especially at locations where the traffic make-up consists of diesel fuel vehicles. Pollution from these vehicles has been linked with declines in lung function and increased respiratory symptoms.

### ***Cancer in North Denver: 1998-2000 (CDPHE 2002)***

The primary focus of *Cancer in North Denver: 1998-2000* was to analyze cancer rates in North Denver compared to those in the Denver PMSA, and to identify behavioral and other risk factors that could be contributing to the observed elevated rates.

The principal findings of the comparisons between North Denver and the remainder of the Denver PMSA include:

- For all cancer types combined, cancer rates in North Denver were statistically higher for men of all racial/ethnic backgrounds combined, and for non-Latino White men and women considered as subgroups.
- For some specific cancer types, cancer rates in North Denver were statistically higher for men and women of all racial/ethnic backgrounds combined, and for non-Latino White men and women considered as subgroups, but not for Latino men or women, nor for non-Latino Black men or women.
- Cancer rates in North Denver were not statistically higher for Latino or non-Latino Black men and women, either considering all cancer types together or for individual types of cancer.

### ***Analysis of Diagnosed Versus Expected Cancer Cases for the Northeast Denver Metropolitan Area in the Vicinity of the Rocky Mountain Arsenal, 1979-1996 and 1997-2000 (CDPHE 2003)***

These two reports, covering the periods 1979 through 1996 and 1997 through 2000, report the initial and follow-up findings of ongoing cancer surveillance for communities in the northeast Denver metropolitan area, specifically the area surrounding the Rocky Mountain Arsenal National Wildlife Refuge in Adams County north of 56th Avenue, Stapleton, and Montbello.

As indicated in both the 1979 to 1996 and 1997 to 2000 analyses, when all cancers were combined together within a study area, there were not statistically significant differences between the study area populations and the Denver metropolitan area population. However, when the data was disaggregated and examined to show different types of cancer, statistically significant differences between the populations of each study area and the Denver metropolitan area population were identified.

***Analysis of Diagnosed Verses Expected Cancer Cases in Residents of the Vasquez Boulevard/I-70 Superfund Site Study Area (CDPHE 2003)***

The *Analysis of Diagnosed versus Expected Cancer Cases in Residents of the Vasquez Boulevard/I-70 Superfund Site Study Area* investigated cancer occurrence for neighborhoods in the Vasquez Boulevard/I-70 Superfund Site in north-central Denver. Previous studies conducted by the U.S. Environmental Protection Agency have indicated high levels of arsenic and lead in soil at some homes in the Elyria and Swansea, Clayton, Cole, and southwest Globeville neighborhoods. The study was conducted at the request of citizen representatives of Colorado People's Environmental and Economic Network and the Cole, Elyria and Swansea, and Clayton Neighborhood Coalition to conduct a review of cancer rates in their community.

CDPHE found an elevated incidence of cancer for the study area. Additional statistical analyses did not detect an association between the occurrence of lung cancer and high levels of arsenic in the soil of homes where individuals with lung cancer lived. CDPHE notes that many or most of the lung and laryngeal cancers reported from these neighborhoods are likely related to smoking. The report also states that other factors, such as exposure to carcinogens in an occupational setting or other chemical exposures from indoor or ambient air, may also contribute to the overall individual and population risk.

